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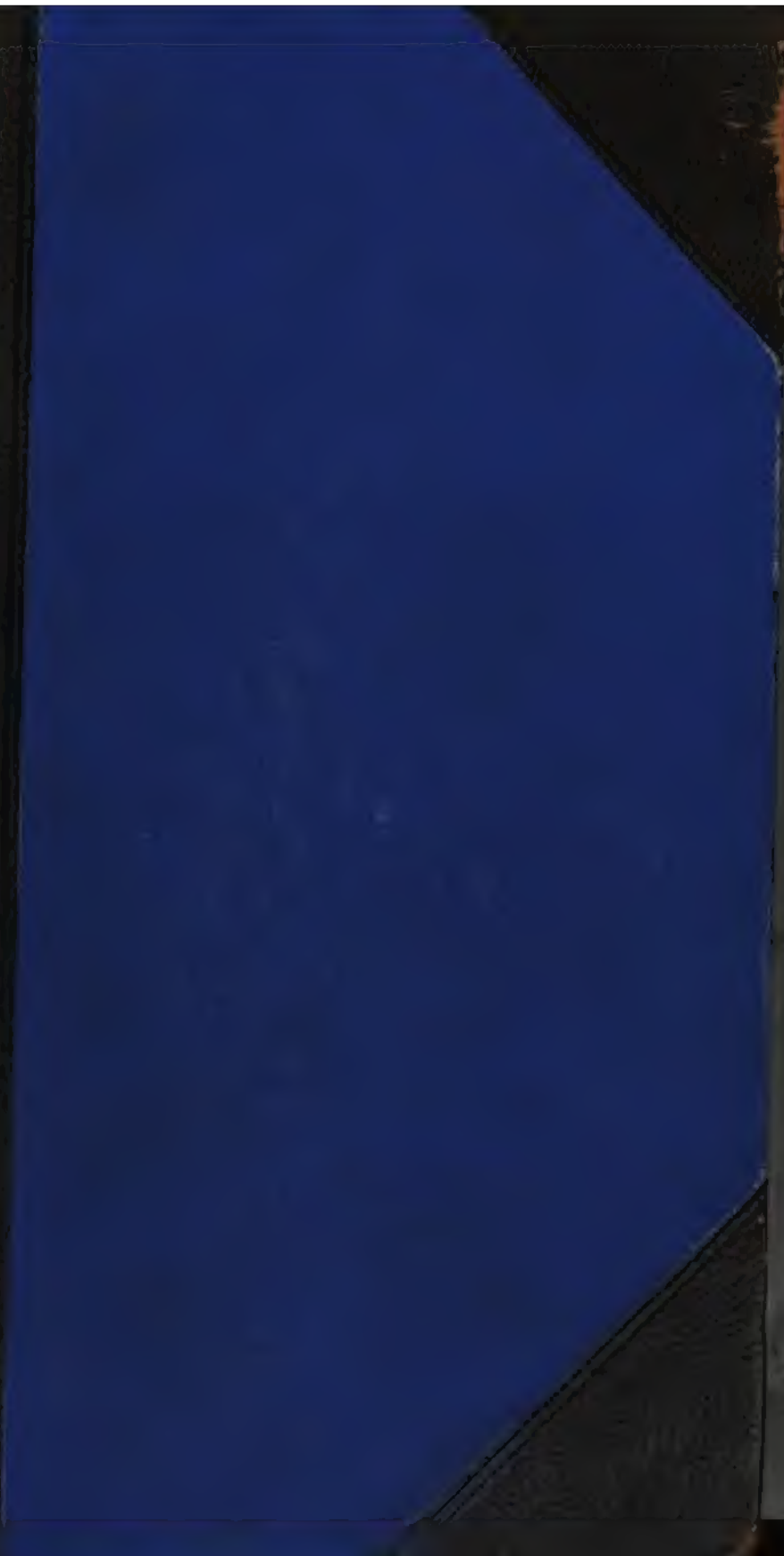
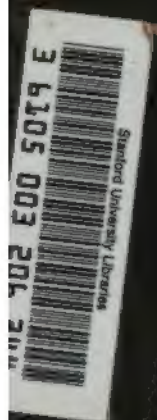
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THE JOURNAL

—OF THE—

AMERICAN CHEMICAL SOCIETY.

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VOLUME XIII.

1891.

---

*COMMITTEE ON PAPERS AND PUBLICATIONS.*

J. F. GEISLER,  
A. C. HALE,  
A. A. BRENNEMAN, Editor.

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List of Officers, Members, etc., for the year 1891.



## THE PHILADELPHIA MEETING.

---

The Second General Meeting of the American Chemical Society was held at Philadelphia in the Physical Lecture Room of the University of Pennsylvania, on December 30th and 31st.

The following chemists were registered at the meeting :

George F. Barker, Philadelphia, Pa.  
C. C. Caldwell, Ithaca, N. Y.  
H. Carrington Bolton, University Club, New York.  
F. W. Clarke, Washington, D. C.  
Albert C. Hale, Brooklyn, N. Y.  
William L. Dudley, Nashville, Tenn.  
Edward P. Harris, Amherst, Mass.  
L. H. Friedburg, College of the City of New York.  
J. A. Mandel, College of the City of New York.  
William Rupp, School of Mines, New York.  
E. H. v. Schweinitz, Washington, D. C.  
C. E. Munsell, New York.  
R. C. Schiedt, Lancaster, Pa.  
A. H. Sabin, Long Island City, N. Y.  
A. A. Breneman, New York.  
Lee K. Frankel, University of Pa.  
Samuel P. Sadtler, University of Pa.  
Edward Hart, Easton, Pa.  
Edward H. Keiser, Bryn Mawr, Pa.  
L. G. Eakins, Washington, D. C.  
H. B. Nason, Troy, N. Y.  
John M. Maisch, Philadelphia.  
George B. Miller, Philadelphia.  
William Frear, State College, Pa.  
Frank H. Rosengarten, Philadelphia.  
Charles M. Cresson, Philadelphia.  
H. H. Nicholson, University of Nebraska.  
Charles B. Dudley, Altoona, Pa.  
Edward Gudeman, Philadelphia.  
L. E. Munoz del Monte, Chestnut Hill, Pa.  
Elwyn Waller, New York.



Walter M. Saunders, Hughesdale, R. I.  
John Howard Appleton, Providence, R. I.  
Reuben Haines, Philadelphia.  
Henry Pemberton, Jr., Philadelphia.  
Morris Loeb, Worcester, Mass.  
T. R. Wolf, Delaware College, Newark, Del.  
Joseph F. Geisler, New York.  
Herbert E. Smith, New Haven, Conn.  
R. Ogden Doremus, New York.  
Marcus Benjamin, New York.  
Walter H. Kent, Brooklyn, N. Y.  
Hugh Hamilton, Harrisburg, Pa.  
Albert R. Leeds, Hoboken, N. J.  
Charles A. Doremus, New York.  
R. R. Fisher, Philadelphia.  
Amos P. Brown, Philadelphia.  
D. K. Tuttle, Philadelphia.  
Albert P. Brown, Camden, N. J.  
Thomas B. Stillman, Steven's Institute, Hoboken, N. J.  
S. T. Skidmore, Philadelphia.  
A. B. Prescott, Ann Arbor, Mich.  
Charles A. Catlin, Providence, R. I.  
A. C. Peale, Washington, D. C.  
Pedro S. Salom, Philadelphia.  
Henry Bower, Philadelphia.  
W. R. Livermore, Corps of Engr's, U. S. Army.  
Durand Woodman, New York.  
J. H. Wainwright, U. S. Laboratory, New York.  
John Marshall, University of Pa.  
William H. Green, Philadelphia.  
Walter J. Keith, Philadelphia.  
Charles T. Pomeroy, Newark, N. J.  
R. H. Bradbury, University of Pa.  
A. W. McCanley, University of Pa.  
Bruno Terne, Philadelphia.  
Nath. Hathaway, New Bedford, Mass.  
J. B. F. Herreshoff, Brooklyn, N. Y.  
William Jay Schiefelin, New York.  
Edgar Richards, Washington, D. C.  
Theodore G. Wormley, Philadelphia, Pa  
Marcus J. Oakes, New York.  
C. E. Munroe, Newport, R. I.  
A. P. Sharp, Baltimore, Md.  
B. G. Morley, Chester, Pa.

The Committees for the Meeting were as follows :

*Committee of Arrangements.*

A. A. BRENNEMAN, Chairman.

WM. RUPP,	C. F. CHANDLER,
A. H. SABIN,	WM. MCMURTRIE.

*Local Committee.*

GEORGE F. BARKER, Chairman,

HENRY BOWER,	GEORGE A. KOENIG,
CHAS. A. BRINLEY,	JOHN M. MAISCH,
ROBERT A. FISHER,	FRANK H. ROSENGARTEN,
FRED'K A. GENTH,	SAMUEL P. SADTLER,
WM. H. GREENE,	PEDRO D. SALOM,
EDW. GUEDEMANN,	WALDRON SHAPLEIGH,
J. W. HOLLAND,	EDGAR F. SMITH,
SAMUEL C. HOOKER,	DAVID K. TUTTLE,
THOMAS S. HARRISON,	WM. H. WAHL,
EDW. H. KEISER,	THEODORE C. WORMLEY.

*Committees of Conference appointed in response to the invitation of the American Chemical Society, in accordance with a resolution of the Newport meeting to consider the question of general organization of chemists in America :*

By the American Chemical Society :

ELWYN WALLER, New York, *Chairman.*

\*C. F. CHANDLER, New York.

J. H. APPLETON, Providence, R. I.

A. C. HALE, Brooklyn, N. Y.

A. A. BRENNEMAN, New York.

By the Chemical Section of the American Association for the Advancement of Science:

F. W. CLARKE, Washington, *Chairman.*

H. CARRINGTON BOLTON, Washington.

W. L. DUDLEY, Nashville.

\*W. H. ELLIS, Toronto.

\*EDWARD HART, Easton.

MORRIS LOEB, Worcester

\*E. W. MORLEY, Cleveland.

C. E. MUNROE, Newport.

A. B. PRESCOTT, Ann Arbor.

\*R. B. WARDER, Washington.

\*T. H. NORTON, Cincinnati.

By the Association of Official Agricultural Chemists:

\*H. W. WILEY, Washington, *Chairman*.

\*W. C. STUBBS, New Orleans.

G. C. CALDWELL, Ithaca.

WILLIAM FREAR, State College, Pa.

H. H. NICHOLSON, Lincoln, Neb.

By the Washington Chemical Society:

\*W. H. SEAMAN, Patent Office, Washington, *Chairman*.

EDGAR RICHARDS, Int. Rev. Bureau, “

\*T. M. CHATARD, Geol. Survey, “

By the Chemical Section of the Franklin Institute:

W. H. WAHL, Philadelphia.

W. H. GREENE.

S. C. HOOKER.

By the Chemical Section of the Brooklyn Institute:

W. H. KENT, Brooklyn, N. Y.

By the Manufacturing Chemists' Association of the United States:

HENRY BOWER, Philadelphia.

The preparations of the Local Committee for the reception and entertainment of the visiting chemists were admirably made and the programme of the meeting was carried out in every detail. The first business session was mainly given to reading of papers, most of which appear in the following pages.

Luncheon was served each day at the close of the session, in another building of the University close to the place of meeting.

On Tuesday afternoon an excursion was made to Gloucester, N. J., to inspect the works of the Welsbach Incandescent Gas Light Company. The process of making the gas lamps was shown in all its stages. The various tints of incandescence produced by varying the composition of the mixture of rare earths that form the mantle or network which becomes incandescent in a gas flame, were beautifully shown.

---

\* Not present.

The most interesting part of the exhibition, however, to chemists was the large collection of compounds of the rare earths, especially those of neodymium and praseodymium.

There were shown :

150 kilos.	of Lanthanum ammonium nitrate,
100 “	“ Neodymium “ “
10 “	“ Praseodymium “ “
10 “	“ Yttrium oxalate from fergusonite,
10 “	“ “ “ “ gadinolite,
50 “	“ Zirconium nitrate.

In addition there were many specimens of oxides, carbonates, sulphates, nitrates, acetates and chlorides of neodymium and praseodymium, many salts of cerium, yttrium, lanthanum, thorium, erbium, etc., and large quantities of monazite, cerite, samarskite, allanite, zircon, etc.

The prodigality in which these compounds were shown and the beauty of the preparations gave the exhibition a peculiar interest and significance for chemists.

The conference of representatives from different chemical organizations met on Tuesday morning and organized with Prof. A. B. Prescott as chairman, and Dr. H. Carrington Bolton, as secretary. The business of the meeting was referred, after some discussion, to a sub-committee, made up of the chairmen of the different committees, and the resolutions reported by this sub-committee were adopted by the conference with some modifications and are given in the Proceedings herewith.

On the evening of December 30th, a reception was given to the visiting chemists, by the chemists of Philadelphia, at the Manufacturers' Club.

The meeting of December 31st was given to the Inaugural Address of President Barker, to hearing the report of the Conference, and to the reading of papers.

In the afternoon visits were made to the U. S. Mint, the Franklin Institute, the Pennsylvania Museum, the Baldwin Locomotive Works, Berger & Engel's Brewery and the Central Station of the Edison Electric Lighting Co.



PROCEEDINGS OF THE SECOND GENERAL MEETING  
OF THE AMERICAN CHEMICAL SOCIETY.

HELD AT THE UNIVERSITY OF PENNSYLVANIA.

---

PHILADELPHIA, PA., December 30 and 31, 1890.

FIRST DAY, DEC. 30TH.

The meeting was called to order at 10:40 A. M. by Prof. H. B. Nason, President.

Prof. Edward Gudeman was appointed Secretary *pro tem*.

Dr. Wm. Pepper, the Provost of the University, was prevented by illness from making his intended address of welcome.

Prof. G. F. Barker read Dr. Pepper's letter of regret and, in the name of the University, welcomed the Society to Philadelphia.

Dr. Greene, Secretary of the Local Committee, read the following list of places to which invitations had been received by the Society :

Welsbach Incandescent Gas Light Co.

The U. S. Mint.

The Franklin Institute.

The Rhodes Mfg. Co.

The Baldwin Locomotive Works.

The Pennsylvania Museum.

The Bergner & Engel Brewing Co.

The Central Station of the Edison Electric Light Co.

The following names were then proposed as members:

Prof. H. Carrington Bolton, University Club, New York.

Prof. L. P. Kinnicutt, Worcester Polytechnic Inst., Worcester, Mass.

Mr. J. T. Evans.

Prof. E. F. Ladd, Agri. Coll., Fargo, N. Dakota.

Mr. F. E. Dodge, N. Y. Tartar Co., Brooklyn, N. Y.

Mr. Wm. D. Crumbie.

Mr. Edward Scherer, U. S. Laboratory, 402 Washington, St., New York.

As associates :

Prof. P. W. Bedford, College of Pharmacy, N. Y.

Prof. Chester Huntington, P. O. Box 1780, N. Y.

Mr. D. H. Burrell, Little Falls, N. Y.

Mr. A. P. Sharp, Baltimore, Md.

The reading of papers being in order the following were read:

\*I. Note on Certain Reactions for Tyrotoxon. H. A. Weber.

II. The Relative Merits of the Wanklyn and the Adams' Method in the Estimation of Fat in Milk Analyses. J. F. Geisler.

III. Exhibition of Alchemical Medals. H. C. Bolton.

IV. Method of Determining Indigo for Commercial Purposes. F. A. Owen.

† V. On a New Gas Burner. L. H. Friedburg.

VI. A Porcelain Gooch Crucible. G. C. Caldwell.

VII. Some New Laboratory Fixtures. G. C. Caldwell.

The meeting was adjourned at 1 P. M.

EDWARD GUDEMAN,

Recording Secretary *pro tem*.

## SECOND DAY, DEC. 31ST.

The meeting was called to order at 11:15 A. M. by the Chairman, Prof. G. F. Barker, President of the Society for 1891, who delivered an Inaugural Address upon "The Borderland Between Chemistry and Physics."

The Secretary of the Local Committee then made some announcements in reference to the afternoon visits.

Prof. A. A. Breneman, Chairman of the Committee of Arrangements, then moved a vote of thanks to the parties named below.

To members of the Local Committee for their unwearying services and their many hospitalities.

\* I and II. were published in December No. of this journal, Vol. XII., 10, 485 and 488.

† V., VI. and VII. will be published in February No.

To Provost Pepper and the Dean and the authorities of the University for the use of the University Building for the meetings of the Society.

To the Board of Managers of the Franklin Institute.

To Col. Barrows and Dr. Waldron Shapleigh, of The Welsbach Incandescent Light Co.

To the Jefferson Medical College.

To Col. Bosbyschell and Dr. Tuttle of the U. S. Mint.

To the Baldwin Locomotive Works.

To the Bergner & Engel Brewing Co.

To Prof. W. D. Marks and associates at the Edison Central Station.

The motion was carried unanimously.

Dr. H. Carrington Bolton, as Secretary of the Conference, was then introduced and reported that there were at the Conference delegates present from seven different bodies, eighteen delegates in all and representing :

The American Chemical Society.

The American Association for the advancement of Science, Chemical Section.

Chemical Section, Franklin Institute.

Chemical Section, Brooklyn Institute.

The Association of Official Agricultural Chemists.

The Manufacturing Chemists' Association of the United States.

The Chemical Society of Washington, D. C.

Prof. Albert B. Prescott in the Chair, Dr. H. Carrington Bolton, Secretary.

The work of the conference had resulted in the formulation of the following

#### RESOLUTIONS.

*Resolution 1.* It is desirable that an American Association of Chemists be formed to embrace all existing American Chemical Organizations.

*Resolution 2.* Resolved, that this Conference recommend to all existing American Chemical Organizations that they call a meeting of their bodies to be held in Washington in connection with the meeting of the American Association for the Advancement of

Science for 1891 and that each of these organizations be requested to appoint a committee, or to continue their present committee for the further discussion of the subject submitted to the Conference now in session.

*Resolution 3.* Resolved, that this general Conference Committee, composed of the present sub-committees, or such others as may be appointed by the several organizations, be called together at as early a time as practicable before the joint meeting recommended in Resolution No. 2.

*Resolution 4.* Resolved, that meanwhile each sub-committee, through its chairman, by correspondence or otherwise, shall formulate such modifications of the Constitution of the American Chemical Society as it shall deem necessary to adapt it to the requirements of the Association proposed.

*Resolution 5.* Resolved that the chairmen of these sub-committees shall then, so far as possible, harmonize the views embodied in these reports of their several organizations and shall have printed for presentation at the joint meeting a report, or majority and minority reports, on a Constitution for the proposed Association of American Chemists.

Voted that the Chairman of this Conference, with Professor Clarke and Professor Hale, be a committee of three to select time and place for the meeting called for in Resolution No. 3.

Voted to request the American Chemical Society to print the minutes of this conference with their report of the proceedings of the Philadelphia meeting and to mail copies as widely as possible to chemists in North America.

The secretary of this Conference is desired to communicate the above resolutions to scientific journals with a view to obtain a wide publication of the same.

Adjourned to meet at call of the Chair.

H. CARRINGTON BOLTON,  
Secretary of the Conference.

Voted that the Chairman of this conference with Prof. Clarke and Prof. Hale be a committee of three to select time and place for the meeting called for in resolution.

It was voted to request the American Chemical Society to print the minutes of this conference in the proceedings of the Philadelphia meeting, and to distribute among the chemists of the country as widely as possible.

The Secretary of the conference was directed to communicate the above resolutions to scientific journals with a view to obtain as wide a publication as possible.

Prof. A. C. Hale moved that the above request to print and circulate proceedings of the conference be adopted. Carried.

Prof. F. W. Clarke advocated a meeting in Washington at the time of the next meeting of the American Association for the Advancement of Science, when a number of other scientific societies would also hold meetings.

Prof. Barker then requested Prof. Prescott to take the chair and the following papers were read :

VIII. Chemical and Physical Changes Attendant upon the Sterilization of Milk. A. R. Leeds.

IX. On the Necessity for the Systematic Inspection of Wells in Cities and Towns. Durand Woodman.

X. Experiments in Milk Analysis. Elwyn Waller.

XI. The Chemical Products of some Disease Germs and Their Physiological Effects. E. A. V. Schweinetz.

XII. National and State Chemists in Criminal Trials. Clark Bell.

Prof. Prescott congratulated the society on the fullness of the meetings, the number and excellence of the papers, and on the promotion of fellowship among chemists.

The meeting was then adjourned.

DURAND WOODMAN,  
Recording Secretary.

# THE BORDERLAND BETWEEN PHYSICS AND CHEMISTRY.

---

BY GEORGE F. BARKER.

---

*An Address delivered on assuming the Chair as President of the  
Society for 1891.*

In thanking the American Chemical Society for the honor it has done me in electing me as its President for the year 1891, it seems fitting that I should use the present opportunity for the purpose of outlining very briefly one or two of the more important relations existing between chemistry and physics, which are now shaping the direction of investigation. The conception of the periodic law, first by Newlands, and subsequently by Lothar Meyer and Mendeléeff, will ever be regarded as marking an important epoch in the progress not only of pure chemistry, but also of the physics of chemistry as well. For not only does this law assert that the purely chemical properties of the elements are periodic functions of the masses of their atoms, but it asserts also that their physical properties are like functions. In consequence, the impetus which these assertions have given to investigation seems but little short of marvellous. Not only were new researches undertaken by the chemist to fix more precisely these atomic masses, new calculations made upon data already accumulated, and new relations experimentally established going to show the position of the doubtful elements in the periodic series; but the most elaborate experiments were begun also by the physicist upon the phenomena of solution, of density, of specific heat, of refraction, of electric conductivity and the like, in order to connect these physical properties with the mass of the atom; and thus to establish the predominant influence of the atom, even in molecular

physics. Maxwell long before had pointed out the advantages to be secured by what he happily called "the cross fertilization of the sciences." And Lord Rayleigh in his presidential address at Montreal, in following out this suggestion, had instanced "the neglected borderland between two branches of knowledge" as that "which often best repays cultivation." "I cannot help thinking," he says, alluding to the progress already made by general chemistry, "that the next great advance, of which we have already some foreshadowing, will come on this side." "If I might without presumption" he adds "venture a word of recommendation, it would be in favor of a more minute study of the simpler chemical phenomena."

At the outset however, it seems to me that a word should be said concerning the terminology of these closely allied sciences. If it be true that in both physics and chemistry, taken separately, precision of thought and consequent precision of language are dependent upon a precise use of terms, how much more true is it in that limiting region which lies between them. The terms here employed are borrowed in the main either from chemistry on the one side or from physics on the other. So that the chemist is quite as much bound to use the terms of physics in the physical sense as the physicist is to use those of chemistry in the chemical sense. As an illustration of this let us take the terms atom and molecule for example. To the chemist they represent perfectly definite portions of matter, the latter in general larger than the former, since the molecule is itself made up of atoms. So that in chemistry the molecule is commonly defined as the smallest particle of any substance which can exhibit the properties distinctive of that particular kind of matter; while the atom is considered to be the smallest particle of simple matter which can enter into the formation of a molecule. To the physicist, however, this distinction is not so obvious. In a lecture, delivered in 1883 before the Royal Institution of Great Britain upon the size of atoms, Sir William Thomson said: "I speak somewhat vaguely and I do not do so inadvertently, when I speak of atoms and molecules. I must ask the chemists to forgive me if I even abuse the words and apply a misnomer occasionally. The chemists do not know

what is to be the atom ; for instance, whether hydrogen gas is to consist of two pieces of matter in union constituting one molecule and these molecules flying about ; or whether single molecules each indivisible, or at all events undivided in chemical action, constitute the structure." The evidence upon which this criticism is founded is unfortunately too common. Vagueness in the use of these terms even among chemists is far too frequent. Bloxam, for example, defines molecules as "the smallest physical particles of matter;" and an atom he says is "the smallest imaginable particle of matter." The subsequent use of the terms atom and molecule as synonymous, in Sir William Thomson's lecture, however, shows that his atom is the atom of the physicist and corresponds to the molecule of the chemist. It is greatly to be desired that some agreement should be reached in the definition of these words. The simplest solution of the problem would be, of course, the abandonment of the word atom by the physicist, except when he makes use of it in the purely chemical sense.

In recent years, perhaps no terms in physics have been more sharply and more properly differentiated, than the terms "mass" and "weight." The former is a quantity of matter and its standard unit of measure is the gramme. The latter is a quantity of force and its unit is the dyne. Hence, strictly speaking, it is as unscientific to speak of a weight of ten grammes, or of a mass of ten dynes, as it is commonly regarded to refer to the length of a rod as having the value of twenty seconds, or to a time as being six yards long. Unfortunately, however, custom has so long sanctioned the use of the former expressions that we have ceased to regard them as inadmissible. Moreover, the law of gravitation tells us that the force of this attraction measured in dynes is directly proportional to the product of the attracting masses, measured in grammes. Whence by ellipsis, we speak of a weight of ten grammes as meaning the attractive force which the earth exerts upon a mass of ten grammes ; *i. e.*, 9800 dynes. And of a mass of ten dynes as the mass upon which the earth's attraction would be ten dynes of force ; *i. e.*, nearly one centigramme. In consequence units of mass have come into use as gravitation units of force.

This confusion of terms is most unfortunate. Mass is invariable



for any given body, no matter in what part of the universe it is and no matter to what conditions it may be subjected. It is an invariable attribute of matter itself. Weight, on the other hand, depends upon the presence and attraction of other bodies in the vicinity of the body in question, and is therefore an entirely accidental attribute of matter. Indeed, a body may have no weight, even in presence of other matter, provided that the sum of the attractions in opposite directions be zero ; as is the case, for example, at the centre of the earth. It is not surprising therefore that in physics it has been found essential to scientific precision, to use the word "mass" whenever quantity of matter is meant, and the word "weight" whenever the force of the earth's attraction is referred to.

Moreover, the distinction now drawn is practically recognized in ordinary life. Because of its convenience, weighing is the process by which mass is ordinarily measured. Coal is bought by the ton, beef by the pound and quinine by the ounce. In all these cases the purchaser desires the particular quantity of these substances indicated by these standards of mass respectively. Not only is the weight concerned, *i. e.*, the earth's attraction, entirely immaterial, but it is often undesirable. In other words, the less the weight, provided the mass be the same, the better. In rare cases it is true that weight as such, is the thing purchased ; as lead for the keel of a vessel or stone for ballast. In the same sense that mass, though proportional to weight is not weight, the standards used in weighing, while proportional to the earth's attraction, are not standards of weight but standards of mass ; *i. e.*, are not weights but are masses.

This confusion, so far from being lessened, is rather increased by the fact that the word "weight" is used in two senses. Not only is it employed to signify force, which is its legitimate definition, but it is also used as a synonym for "mass"; so that in many cases it is quite impossible to determine the particular sense intended. A definition, it has been well said, should clearly distinguish the thing defined from everything else. What place then can a term have in exact science, which, like the word "weight" connotes two entirely distinct ideas? For this reason it is that

the use of the word "weight" in the sense of mass has well nigh disappeared from the terminology of pure physics. The quantity of matter in a body is now always called its mass and is expressed in units of mass or grammes. The earth's attraction upon this quantity of matter is called its weight and is expressed in units of weight or dynes. Standards used in determining mass by weighing are properly termed standard masses and not standard weights. Moreover, the same is true of the terms derived from these fundamental ones. Density is the mass contained in unit volume and the density of a substance is the number of grammes of mass which occupies a cubic centimetre. The idea of specific gravity is retained in the term "relative mass," which is defined as the ratio of the mass of a body to the mass of an equal volume of water. In the same way, one body is said to be more massive than another when its mass is absolutely greater; and denser, when its mass is relatively greater; instead of using the term "heavier" in both cases. In short, physics has decreed, in order to secure the precision essential to scientific progress, that an absolute divorce should be granted between the terms "mass" and "weight," each being used only in its proper sense.

Chemistry, however, has hardly yet begun to recognize the importance of this decree; and in consequence serious confusion of ideas continues to result. In the 7th edition of an English chemistry of considerable repute, just issued from the press, I find for example the following definition: "Matter, in a chemical sense, is anything which possesses weight." Evidently the word "weight" cannot here be used in its legitimate sense of gravitative force; because at the centre of the earth matter exists, although it has no weight. It must therefore be employed in the sense of mass; and the sentence may be read "matter is anything which possesses mass": *i. e.*, quantity of matter. Thus read it becomes a truism and not a definition. It is this use of the word "weight" as a synonym for "mass," and which is clearly illegitimate, which is so common in chemical literature and which is so unfortunate. Thus I find in the Chemistry just referred to, the statement that "the unit of weight now very generally adopted by scientific chemists is one gramme of hydrogen, which measures 11.16 litres at 0° C. and

760 m.m. Bar ;" a statement most perplexing to the average student, in comparison with the declaration "the unit of mass is a gramme," which is all that the quotation really states.

If all this be granted, and I think it must be, then another and a more radical change should be made in chemical terminology. I allude to a change in the expressions "molecular weight" and "atomic weight." Using the word "weight" absolutely and in its legitimate sense, these terms, as they are commonly used, have no meaning whatever. Neither the absolute attraction of the earth for a molecule nor its attraction for an atom, expressed in dynes, can have any constant value, since the earth's attraction is not the same at different points of its surface. How much more absurd then is it to speak of the absolute weight of an atom, say of hydrogen, as being the same upon the sun or upon a fixed star. If, however, the claim be made that the word "weight" is here used, not in an absolute but in a relative sense, then it appears to me that the whole question is conceded ; since it is granted that the attribute implied in the term used must of necessity be an invariable attribute, independent of time and place, and this, in its essence, the word "weight" is not. It is true, of course, that relative atomic and molecular weights are invariable ; but this is evidently only because the absolute weight of the standard of comparison varies from place to place, and in the same direction. Precisely as the apparent weight of a mass of lead would be constant everywhere if balanced against a standard kilogramme.

But this use of the word "weight" is not the use generally implied in the terms atomic and molecular weight. It is used in chemistry almost without exception as a synonym of the word mass. The very conception of an atom or of a molecule is that of a definite mass of matter. Atoms, says Lothar Meyer, are "individual isolated particles of matter, possessing definite and unvarying weights ;" *i. e.*, masses. Even vortex atoms "are small but finite systems of matter which rotate about an endless curve as axis, and which, according to the investigations of Helmholtz, possess the peculiar property that their mass cannot be affected by external influences." Muir tells us that "the symbol of an element, *e. g.*, H, O, Cl, or of a compound, *e. g.*, H<sub>2</sub>O, HCl, repre-

sents a definite mass of that element or compound"; and he defines "the maximum atomic weight of an element" as "the smallest mass. in terms of hydrogen as unity, of that element in a molecule of any compound thereof." "To every element" he says, "a number may be given which expresses the smallest mass of that element which combines with unit mass of some element chosen as a standard. These numbers also express the smallest masses of the various elements which severally combine with each other." So Remsen, in stating the law of multiple proportions, says: "If two elements, A and B, form several compounds with each other and we consider any fixed mass of A, then the different masses of B which combine with the fixed mass of A, bear a simple ratio to one another." In illustrating this law he states: "The mass of oxygen combined with a given mass of carbon in carbon dioxide is exactly twice as great as the mass of oxygen combined with the same mass of carbon in carbon monoxide." Again, the law which underlies all chemical action is known as the law of the conservation of mass. It asserts that "the mass of matter which takes part in any change, whether physical or chemical, remains unaltered." And, finally, we have the important law of the action of mass, which is thus given by Remsen: "Chemical action is proportional to the active mass of each substance taking part in the change."

Moreover, the terms "atomic mass" and "molecular mass" refer equally to invariable quantities of matter, whether the word mass be taken in the absolute or in the relative sense. The absolute mass of an atom of sodium is the same, at least if we may judge from the period of its vibration, upon the sun, Sirius and Aldebaran, as upon the earth. And invariability of absolute mass necessarily involves invariability relatively. At present, the atomic masses of the elements given in our text books, are all relative, being expressed in terms of that of hydrogen, taken as unity. But it is evident that from these relative masses, the absolute atomic masses of all the elements can be obtained by simple multiplication, so soon as we know the absolute mass of the hydrogen atom. According to Lothar Meyer, "under a pressure of one atmosphere and at the mean temperature of about

20°, one cubic millimetre of any gaseous substance which obeys Avogadro's law contains about 21 trillions of molecules. But as one cubic centimetre of hydrogen under the given conditions weighs (*i. e.*, has the mass of) 0.0835 milligramme, the weight (mass) of a molecule of hydrogen must be  $\mathfrak{S}=\text{H}_2=\frac{0.0835}{21.10^{18}}=$

$\frac{4}{10^{21}}=0.000,000,000,000,000,000,004$  milligrammes; or a quadrillion molecules of hydrogen weigh (have a mass of) about four (milli) grammes."\* Hence if we may assume that such a molecule as this is the molecule of Avogadro's law and consists of two atoms the conclusion is easy that a quadrillion hydrogen atoms have an absolute mass of two milligrammes. Whence the absolute mass of a quadrillion chlorine atoms is 70.74 milligrammes, of a quadrillion oxygen atoms 31.92 milligrammes, of a quadrillion nitrogen atoms 28.02 milligrammes, etc. In other words, the number expressing the relative molecular mass of an element, represents in milligrammes the absolute mass of a quadrillion atoms of that element.

These considerations make sufficiently evident, I think, the great gain that would accrue to chemistry in clearness of conception and precision of expression, were the word "mass" always to be employed whenever quantity of matter is referred to and the word "weight" only when the force of the earth's attraction is meant. True it is indeed, that the adoption of this rule will oblige us to give up the older and more familiar terms "atomic weight" and "molecular weight," and to substitute in their places the newer ones "atomic mass" and "molecular mass." But true progress in any science is attended with frequent revisions of its terminology; and in none more than in chemistry. It is a sufficient reason for such a change to show that thereby the science becomes better equipped for the further conquest of truth.

Returning now from this digression, it seems to me that one of the most noteworthy steps of progress recently taken is to be found in the analogy pointed out by Van't Hoff, between

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\* Modern Theories of Chemistry, p. 111.

gases and dilute solutions. In pure physics, the kinetic theory of gases as developed by Clausius, Maxwell, Boltzmann and others has led to the most important generalizations and has established the constitution of gaseous masses upon a firm foundation. From the simple assumption that the molecules of matter in the gaseous state are moving in straight lines, and that they are subject in consequence only to the laws of mass motion, conclusions have been derived which agree so closely with the facts as to make it appear that the properties exhibited by substances when in the gaseous state are necessary results of this fundamental hypothesis. Permit me briefly to recapitulate some of these conclusions. It follows in the first place that the pressure exerted by a gas outwardly is due simply to the impact of its molecules; so that if  $m$  be the mass of a molecule and  $v$  its speed  $\frac{1}{2}mv^2$  will represent its kinetic energy and  $\Sigma \frac{1}{2}mv^2$  the kinetic energy of the mass of unit volume; a value which becomes  $n \cdot \frac{1}{2}mv^2$ , if  $n$  like molecules having a mean speed  $v$  are contained in unit volume. For a second gas, the kinetic energy of unit volume will be  $n' \cdot \frac{1}{2}m'v'^2$ , of course. But since the outward pressure exerted by the gas is due to its kinetic energy, this energy must be the same for equal volumes of any two gases when they are under the same pressure; *i.e.*, that of the atmosphere. Whence we have

$$n \cdot mv^2 = n' \cdot m'v'^2$$

If now these two gases have the same temperature, they are in thermal equilibrium and  $mv^2 = m'v'^2$ ; whence  $n = n'$  and the number of molecules in unit volume is the same for both gases; which is the law of Avogadro. Moreover, since  $mv^2 = m'v'^2$ , we have  $v^2 : v'^2 :: m' : m$ ; or the speed of translatory motion in a gas is inversely proportional to the square root of its molecular mass; *i.e.*, of its density; which is Graham's law of diffusion. Again, since the molecules are moving in all directions we may resolve this motion along three perpendicular axes; so that the actual pressure in any one direction is  $p = \frac{1}{3}nmv^2$ . Now although we may not know the actual value of either  $m$  or  $n$ , yet we do know their product  $mn$ , which is the mass of the molecules in unit volume; *i.e.*, the density of the gas. Representing this by  $\delta$ , we have  $p = \frac{1}{3}\delta v^2$ . Hence the density of a gas varies directly as

the pressure upon it; which is the law of Boyle or Marriotte. Since  $V=1/\delta$ , or the volume of a gas is inversely as its density, the law may be stated in its ordinary form—the volume of a gas varies inversely as the pressure upon it. So, since  $\delta = mn$ ,  $\delta' = m'n'$ , and  $n = n'$ , we have  $m : m' :: \delta : \delta'$ ; or the molecular masses of two gases are directly proportional to their densities, which is the law of Gay Lussac. If the temperature is constant, the mean speed is constant, and  $pV$ , which equals  $\frac{1}{2}v^2$ , is also constant. As  $pV$  is proportional to the absolute temperature,  $v$  must be so. Hence the volumes of all gases are proportional to the absolute temperatures, and therefore expand and contract equally by heat; which is the law of Charles. From the equation  $v^2 = 3p/\delta$  we may calculate this mean speed of translation. Thus for hydrogen at  $0^\circ$ , Clausius obtained  $v = \sqrt{\frac{3 \times 1033 \times 980}{.0000896}}$  or 1844 metres

per second. For oxygen it is 461 and for nitrogen 492 metres. The fruitfulness of the kinetic theory, it will be noticed, is not confined to physics, even in the case of gases, since it is upon the law of Avogadro, a direct conclusion from it, that the ordinary method of fixing molecular masses by means of vapor-density depends.

A like richness of results seems likely to follow the application of the kinetic theory to solutions. Van't Hoff supposes "a solution contained in a vessel of semi-permeable material, that is to say material permeable only by water molecules but not by the molecules of the dissolved substance, and that this vessel is immersed in water. Then owing to the attraction of the molecules of the dissolved substance, water will enter the vessel, thus causing an increase of pressure, and this will continue until the pressure within the vessel is sufficient to counterbalance the attraction exercised by the molecules of the dissolved substance. Equilibrium being thus established the pressure within the vessel is equal to the osmotic pressure and may be taken as a measure of it." Evidently by providing the vessel with a piston the pressure may be varied so that water may be made to flow out of the vessel or into it, at will. Hence in this way it becomes possible to produce a reversible cycle



of changes like that of Carnot, to which the second law of thermodynamics may be applied. Thus by decreasing the pressure water enters, and then by increasing it again water issues; so that the liquid may be brought back to its original state, the sum of the positive and negative work done upon and by it being zero. Now Van't Hoff has experimentally shown that in isotonic solutions, *i. e.*, solutions for which the osmotic pressure is the same, the pressure is directly proportional to the concentration. But as the concentration is proportional to the density, this is evidently equivalent to the statement that the osmotic pressure of a solution is directly proportional to its density; which is Boyle's law applied to liquids. Moreover, "if we consider the entrance of the water and subsequent increase of pressure to be proportional to the number of molecules which come into contact with the walls of the cell in a given space of time, the argument is similar to that by which Boyle's law is looked upon as due to molecular bombardment" in the case of gases. The same result has been obtained by Duhem by applying the law of the thermodynamic potential to osmotic relations, as a purely theoretical deduction. Again, it has been experimentally shown that the theoretical conclusion deduced by the aid of one of the reversible changes just mentioned, to the effect that the osmotic pressure is proportional to the absolute temperature, is true for a variety of solutions. But this is the law of Gay Lussac applied to such solutions. A third theoretical deduction from the reversible cycle principle is that a gas when in solution, has an osmotic pressure equal to the pressure of the same gas when in a free state. But this is simply an extension of the law of Avogadro to solutions; so that we may say "that for equal osmotic pressures and equal temperatures, equal volumes of different solutions contain the same number of molecules;" this number being the same as that which is contained in the same volume of a gas under the same conditions of pressure and temperature. In fact, Van't Hoff has shown that the osmotic pressures of a one per cent. sugar solution at different temperatures agrees with the pressure exerted by hydrogen gas containing the same number of molecules at the same temperature. Further, Duhem has obtained an expression, as a deduction from thermo-



dynamic theory, by means of which when the vapor-pressure of a solution is known, the law of compressibility of water vapor being also known, it becomes possible to calculate the vapor pressure of an isotonic solution. So that assuming the laws of Boyle and Gay Lussac to be applicable to water vapor, it follows that two isotonic solutions at the same temperature have approximately equal vapor pressures. Moreover, Duhem finds that theory proves the law of Van't Hoff that two isotonic solutions have the same solidifying point at the pressure for which they are isotonic, to be rigorously true. From the simple conclusion, deducible as a corollary from these laws, that solutions in the same solvent which have equal maximum vapor pressures or equal freezing points, must be isotonic, the well known law of Raoult, connecting the molecular reduction of the freezing point and the vapor-pressure with the molecular mass, may be readily obtained; provided always that Avogadro's law holds for solutions. The great value of this law of Raoult in fixing the molecular mass, especially of organic non-volatile solids, has been very generally recognized. It may be enunciated thus: A molecule of any compound substance when dissolved in 100 molecules of any liquid upon which it has no action reduces the freezing point of this liquid by a quantity which is nearly constant and which closely approximates to 0.62. As an example of the method of applying the law, the following experiment may here be cited. A solution of dextrose containing 8.3704 grammes in 94.86 grammes of water was observed to freeze at  $-0.94^{\circ}\text{C}$ . Hence its molecular mass is

$$M = T \frac{P}{C} = T \frac{100x}{CF} = 19 \frac{100 \times 8.3704}{0.94 \times 94.86} = 179$$

In this equation  $M$  is the molecular mass,  $T$  the molecular depression,  $C$  the observed depression,  $x$  the grammes of the substance and  $F$  the grammes of water in 100 grammes of the solution. Since this value is practically the same as 180, the value calculated from  $\text{C}_6\text{H}_{12}\text{O}_6$ , it follows that the formula ordinarily given for dextrose represents correctly its molecular mass. The results obtained by this method for colloids are extraordinary. Thus Sabanéeff finds for the molecular mass of colloidal tungstic acid values from 679

to 995, for molybdic acid 608–631, for glycogen 1545–1625, for silicic acid 800 to 1600, and for egg-albumin 15,000.

A second subject of recent interest lying in the borderland between physics and chemistry, to which I would ask your attention is that of electrolysis, a phenomenon now regarded as a true electrical convection of atoms; “a procession of positively charged atoms travelling one way and a corresponding procession of negatively charged atoms the other way,” as Lodge tells us. The charges thus carried are all precisely the same for atoms of the same valence; and they have therefore a minimum value for monads, twice this value for dyads, three times this for triads, etc. This minimum value is the smallest quantity of electricity that is known to take part in any physical or chemical change and has been called therefore a natural unit of electricity. If we may assume the data given by the kinetic theory, this monad charge may be calculated. Since according to Lodge, to decompose one gramme of water  $1.5 \times 10^{13}$  electrostatic positive units must be expended in charging the two hydrogen atoms in each molecule; and since in one gramme of water there are  $10^{25}$  molecules, the charge upon the hydrogen of each molecule will be  $1.5 \times 10^{-12}$  electrostatic unit; or nearly  $10^{-12}$  electrostatic unit on each hydrogen atom. This is about the 400 trillionth of a coulomb. Since the potential of a charged sphere is the ratio of its charge to its radius, the potential of the electrified hydrogen atom would be  $10^{-12}/10^{-10}$  or  $10^{-2}$  electrostatic unit; about 3 volts. The attraction between two atoms, say of hydrogen and chlorine thus charged, being proportional to  $Q^2/d^2$  is  $10^{-24}/10^{-20}$  or  $10^{-4}$ ; about one ten thousandth of a dyne only. Owing to its small mass however, even this force is sufficient to impress upon it an acceleration nearly a trillion times greater than that produced by the attraction of gravity. Helmholtz in his Faraday lecture, has calculated the attraction exerted by these atomic charges, and finds that the charges on the atoms in one milligramme of water, if these could be separated and distributed upon two spheres a kilometre distant from each other, would produce a force of attraction equal to the weight of 26800 kilogrammes. This electric force, he calculates, is 71000 billion times greater than the gravitative attraction of the hydrogen and oxygen atoms. “Although

therefore" he says "the attracting forces exerted by the poles of a little battery able to decompose water, on such electric charges as we can produce with our electric machines, are very moderate, the forces exerted by the same little apparatus on the enormous charges of the atoms in one milligram of water may very well compete with the mightiest chemical affinity." "I think" he concludes "the facts leave no doubt that the very mightiest among the chemical forces are of electric origin."

One of the most noteworthy of the phenomena of electrolysis is the fact that the ions set free by the action of the current appear only at the electrodes; and this, although there is a continuous procession of these electrically charged ions traveling in each direction. The hypothesis of Grotthuss, that a series of decompositions and recompositions occurs along the line of molecules between the electrodes, although suggestive, is defective in that the molecules are assumed to be at rest; and moreover, it requires the expenditure of some energy within the electrolyte itself; "and no hypothesis which involves a tearing asunder of molecules in the interior of a homogeneous electrolyte can be permitted." As early as 1851, Williamson, in his classic paper on etherification, had suggested the idea that in the collisions between molecules, atomic exchanges were continually effected. In 1857, Clausius applied this hypothesis to electrolysis. In his view "the separation of the ions is due to the active movements of the particles, molecules as well as atoms, which tend to bring about the dissociation of the compound, so that only bodies capable of dissociation can act as electrolytes. For the purpose of electrolysis it is not necessary that this dissociation should proceed as far as the complete separation and isolation of the constituents, but it is sufficient that there should be a frequent exchange of their constituents when two particles collide, so that each constituent can for a very short time move apart from the others before it again finds an opportunity of uniting with another isolated particle. This sporadic occurrence of isolated molecular fractions is not perceptible to our senses, so long as they are uniformly distributed throughout the whole mass of the electrolyte, but it is only perceptible when some external action collects large quantities of one class of particles at

one place and of the others at another." This view of continual decomposition and re-formation of molecules has a certain analogy with the theory of exchanges in heat. It "forms the basis of the kinetic theory of chemical changes now universally adopted." "In order to explain electrolysis it is necessary to assume that as each molecule decomposes, one portion of it carries off a definite fixed amount of positive electricity and the other an equivalent quantity of negative electricity. The electricity is either attached to each particle before the separation or else it is produced at the moment of decomposition. Clausius regards the movement of the charged ions in opposite directions as due to the free electricity present upon the electrodes. Here the ions receive from the electrodes an equal quantity of the opposite electricity, and so become neutral. Evidently the vast majority of molecules in an electrolyte are quite insusceptible to the influence of the electrodes. It is only the small number of these molecules which are dissociated by collision or otherwise and whose atoms are set free each with its appropriate charge that respond to the directive tendency of the electrodes. Hence the electrolytic conductivity of a solution depends not only upon the mobility of the molecules within it but also upon the number of such molecules dissociated. Researches by Wiedemann and others upon the relation existing between the internal friction or viscosity of liquids and their electrolytic conductivity have shown the close connection between this conductivity and the mobility of the molecules, and have proved resistance to conductivity to be a constant of the same order as resistance to friction. Moreover, Long has observed that liquid conductivity and diffusion run parallel under similar external conditions; that a substance which diffuses rapidly, is, as a rule, a good conductor. This close connection between speed of diffusion and conducting power is evidence in favor of the view that it is only the movement of the ions and not their separation which is the work of the electricity. When a weak solution is made stronger, the increase of conductivity is due to increased dissociation. When a cold solution is made hotter, the increase is probably due to the diminished viscosity of the liquid.

This movement of the ions, the anion toward the anode and the

kation toward the kathode, has been called by Hittorf the migration of the ions; and he has shown that the speed of travel of the ions is not the same for them all. Thus for example, if a dilute solution of copper sulphate be electrolysed with copper electrodes, the solution at the kathode becomes weaker while that at the anode becomes stronger. Evidently the explanation of this result is to be found in the fact that the anion  $\text{SO}_4$  travels faster than the kation Cu. This subject has been further investigated by Kohlrausch, who adopts the view that electrolytic conduction is performed by dissociated atoms, each of which carries the same numerical charge of electricity, one set of these atoms being positive, the other negative. The speed of the ionic motion, he agrees with Quincke in believing to be proportional to the slope of potential through the liquid. But he maintains that every ion has a specific speed of its own in a given liquid and when urged by a given slope of potential; this speed being wholly independent of all other conditions. In proof of this position he has shown how to calculate this specific ionic velocity in absolute measure, from data founded on conductivity, concentration and migration. Hydrogen travels faster than any other kind of atom. And therefore since the conductivity of a liquid depends on the sum of the speeds of the two opposite atoms of the dissolved substance, acids are in general better conductors than their salts. The rates at which the following atoms can make their way through nearly pure water, when urged by a slope of potential of one volt per linear centimetre, are given by Kohlrausch as follows, in centimetres per hour: Hydrogen 1.08, potassium 0.205, sodium 0.126, lithium 0.094, silver 0.166, chlorine 0.213, iodine 0.216, and  $\text{NO}_3$  0.174.

It would be interesting, did time permit, to consider the more recent progress made by spectrum analysis in its relation to chemical questions. The investigations of Auer, of Krüss and Nilson, of Boisbaudran and of Crookes have gone far to unsettle completely our previous conception of elementary matter. In place of atoms having identical masses, the new theory offers us a collection of variable masses, grouped about a definite mean position, representing the atomic mass. By the ordinary operations of chemistry groups only can be distinguished; these operations being far too

coarse to discriminate between the variable masses of a group. But the application of more refined processes, especially when long continued and made cumulative, readily effects this differentiation, and resolves matter hitherto considered elementary into sub-groups of substances to which Crookes has given provisionally, the name "meta-elements." The oscillations of the mighty electric pendulum which he supposes distributed the primordial matter on alternate sides of a median line as the all-pervading "protyle" or "urstoff" periodically condensed into atomic groups under the influence of the slowly decreasing temperature, is a conception of the genesis of the elements worthy in every way of its distinguished author. "Swinging to and fro to points equidistant from a neutral centre; the divergence from neutrality conferring atomicity (valence) of one, two, three and four degrees as the distance from the centre is one, two, three or four divisions; the approach to or retreat from the neutral line deciding the electronegative or electropositive character of the element, all on the retreating half of the swing being positive and all on the approaching half negative," the oscillations gradually decreasing in amplitude and the masses of the atomic groups continually increasing as the temperature falls, "this oscillating force must be intimately connected with the imponderable matter, essence or source of energy we call electricity." "The pendulum begins its swing from the electropositive side; lithium next to hydrogen in simplicity of atomic weight is now formed; then glucinum, boron and carbon. Definite quantities of electricity are bestowed on each element at the moment of birth, on these quantities its atomicity (valence) depends and the types of monatomic, diatomic, triatomic and tetratomic elements are fixed. The electronegative part of the swing now commences; nitrogen appears, and notice how curiously position governs the mean dominant atomicity. Nitrogen occupies the position below boron, a triatomic element, therefore nitrogen is triatomic. But nitrogen also follows carbon a tetratomic body and occupies the fifth position counting from the place of origin. How beautifully these opposing tendencies are harmonized by the endowment of nitrogen with at least a double atomicity and making its atom capable of acting as tri- and

pentatomic. With oxygen (di- and hexatomic) and fluorine (mon- and heptatomic) the same law holds and one-half an oscillation of the pendulum is completed. Again, passing the neutral line the electropositive elements sodium (monatomic) magnesium (diatomic), aluminum (triatomic) and silicon (tetraatomic) are successively formed and the first complete oscillation of the pendulum is finished by the birth of the electronegative elements phosphorus, sulphur and chlorine; these three, like the corresponding elements formed on the opposite homeward swing, having each at least a double atomicity depending on position." The significance of this hypothesis, however, lies in the experimental data obtained by Crookes himself, upon which it is based. By fractional precipitation with ammonia, repeated many thousand times, he established the fact that the element called yttrium consists certainly of five and probably of eight constituents; these constituents being characterized by special spectrum bands. A similar research on didymium led Krüss and Nilson to conclude that this element may be split into nine distinct components. Other elements, examined likewise by fractional methods, give signs of breaking down and affording "meta-elements." But here the importance of the spectrum method appears. It is solely by the character of the spectrum, obtained either by emission, by phosphorescence, or by absorption, that these constituents can be satisfactorily distinguished. And the pertinent question at once arises, is the presence of a single spectrum line of definite wave-frequency, characteristic of a meta-element? Or, in other words, has the meta-elemental atom only a single rate of vibration, so that in a group of such atoms, constituting what we now term an element, we may reason to the elemental complexity from the number of such meta-elemental spectrum lines?

Such facts as these it is which the chemist of to-day is called upon to correlate with his older knowledge. Do they not indicate most clearly a tendency toward a true statics and dynamics of atoms; toward a condition of exact science which will confer upon chemistry the power of prediction? The future of such a chemistry will be glorious. It will become the grandest of the sciences and its phenomena will task the highest powers of intellectual ac-

tivity. It is to the advancement of such a science; fellow members of the American Chemical Society, that we are privileged to devote our energies. May we each contribute something to hasten its progress.



## EXHIBITION OF ALCHEMICAL MEDALS.

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BY DR. H. CARRINGTON BOLTON.

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The speaker exhibited perfect facsimiles of three medals struck to commemorate alleged transmutations.

No. 1 bears no date, but as it bears the name of Francis II., Duke of Saxony, it can be assigned to the period between 1581 and 1619. The original purports to be of silver; on the obverse are many inscriptions arranged within and without a central triangle, accompanied by emblematic devices. The reverse is of a similar character, and has symbols of antimony and calx. The medal is mentioned by Reyher and other numismatists.

No. 2 has the appearance of a piece of soft white metal hammered into shape by an unskilled hand. The obverse has a representation of Saturn as Chronos, and the reverse bears the following inscription (Translation): "In the month of July, 1675, I, Doctor J. J. Becher, transmuted by hermetic art this ounce of purest silver from lead." This inscription associates this unique medal with the eminent German chemist, Johann Joachim Becher, who, with Stahl, founded the Phlogistic Theory. His biography is well known.

No. 3 is of suppositious gold and adorned with figures and letters in high relief. The obverse has a large figure of Saturn, and the symbol for lead, with the words "A golden offspring begotten of its parent lead." The reverse bears no ornaments but has a long Latin inscription setting forth that this piece was struck at the Castle of Ambros in the Tyrol, in commemoration of a transmutation effected December 31st, 1716, by His Highness, Charles Philip, Count Palatine of the Rhine.

The originals of these medals were found by Dr. Bolton in the Imperial Cabinet of Coins, Vienna; the Director of the Cabinet



kindly allowed him to have plaster casts made, and from these handsome metallic facsimiles were made by courtesy of the Asst. Keeper of Coins and Medals of the British Museum. Two sets were made, one of which was presented to the British Museum. These are shown in the accompanying cuts. It is believed that numbers 2 and 3 have never been described by numismatists.

They form extraordinary and tangible proofs of the sincerity of the widely prevailing belief in transmutation that existed for centuries. Full descriptions of these medals and more than forty others will be found in a paper entitled "Contributions of Alchemy to Numismatics," read before the American Numismatic and Archæological Society, Dec. 5th, 1889, and published in their journal.

## METHOD OF DETERMINING INDIGOTINE FOR COMMERCIAL PURPOSES.

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BY F. A. OWEN.

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Under the above heading the author published a paper in this journal in Nov., 1888; the process as there described has been materially modified, and as now practised in the mills of the Burlington Woolen Company, at Winooski, Vt., is as follows:

From the sample shave off and coarsely powder two or three grammes, from which weigh with exactness two portions of one gramme each. In the first determine the moisture by drying in a watchglass at 100° C. and afterwards ignite this portion and determine the ash. The second portion is brushed from the scale-pan directly into a glass mortar, ground for a time dry, then water is added and the grinding is continued for some time; the pestle is rinsed into mortar and the whole allowed to settle for a minute or so, and all that will freely pour off is decanted into a glass stoppered, 200 c. c. flask. The sediment is reground with water, and

decanted as before until the whole has been transferred. Three grammes of zinc dust and 60 c. c. of commercial strong ammonia are now added ; then the flask is filled to  $\frac{1}{2}$  c. c. above the mark and shaken. Reduction takes place in from half an hour to two hours, during which time it should be shaken occasionally. When the reduction is complete the froth will subside and the solution become pale yellow, or, with some samples which contain chlorophyll or some non-reducible green coloring matter, greenish yellow. Then remove with a pipette 50 c. c. to a beaker or porcelain dish, add five or six drops of ether and agitate by blowing air through with the pipette, until most of the indigotine is precipitated. Acidify in moderate excess with HCl, heat to boiling, and pass through a tared filter ; dry at 100° C., and weigh. It is not necessary to take any special care to prevent absorption of moisture while weighing, only the filter paper must be, as nearly as possible, in the same condition as when tared. The results are accurate. The lots when bought and retested should show no variation from the sample except in the percentage of moisture, which will be higher than in the sample. Indigo often loses 20% in drying, and not infrequently yields 80% of indigotine, after drying.

## THE CHEMICAL AND PHYSICAL CHANGES ATTENDANT UPON THE STERILIZATION OF MILK.

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BY DR. ALBERT R. LEEDS.

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When milk is sterilized by heating in loosely plugged flasks immersed in a steam bath surface evaporation does not occur, and there is little or no pellicle formed on the surface, the sterilized milk presenting the same appearance, if the heat is not continued longer than one or two hours, as the original. Under the microscope the only visible changes effected in the boiled and sterilized milk is the coalescence of some of the fat globules into others of larger size, and the appearance of more shreds or coagula of separated caseinous matter.

The differences in the behavior of raw, boiled and sterilized milk when treated with dilute acid were not by any means as striking as anticipated. It is frequently stated that the precipitate formed with the two latter, requires less acid for its formation, is formed more quickly, and is in softer, finer, more flocculent masses than the clot or curd of raw milk. But on treatment with equal quantities of dilute acid added in successive portions, and waiting for equal intervals, I have not been able to satisfy myself that much difference between the three milks, exists. This is especially true when the separated casein, which is present in raw milk, has already been partly removed with the skin formed on heating, and which itself tends to increase the size and density of the clots of acidulated raw milk. It is indeed very difficult to form a judgment when the undiluted milks are used, since the clots remain suspended in the remaining cloudy liquid, and their size and appearance can readily be modified by manipulation and shaking. Better to see what takes place, each milk was diluted to twenty times its original volume with water, ten cubic centimetres of the

milk being taken, and then a cubic centimetre of acetic acid which itself had been diluted ten times was added. At first the flocks in the raw milk formed a precipitate more dense and occupying at the bottom of the vessel a notably less volume, than that precipitating out of the sterilized milk. In the former case the supernatant liquid was also more opaque from unprecipitated white particles, but after standing 12 hours, these differences in the bulk of the precipitate had disappeared, while the supernatant liquid from the sterilized liquid had a white turbidity and that from the raw milk was perfectly clear. The boiled milk failed to precipitate at all, and an additional cubic centimetre of acid had to be added to before its casein was thrown down.

It is necessary to have recourse to more accurate methods to discover the nature of the changes effected by heating. And the more important and striking is the following. When ordinary raw milk is diluted with 20 times its volume of water, and the precipitate is filtered off, the dilute acid filtrate gives on boiling an additional precipitate. Milk which has been heated for an hour (sterilized), or boiled for half an hour, behaves altogether differently. It gives a larger amount of precipitate with dilute acid, but yields no further precipitate on boiling the filtrate. The precipitate obtained with dilute acid must certainly be different in character, therefore, when raw milk is used and when cooked milk is tested, even though the differences are difficult to recognize by the eye alone.

If we call the albuminoid matter first precipitated C; that separated on boiling A, and that remaining in solution even after boiling the acid liquid, P, the result obtained by experiment on a sample of milk, raw, boiled for half an hour, and sterilized for one hour were as follows :

	Raw.	Boiled.	Sterilized.
Total Albuminoids	3.303 per cent.	3.481 per cent.	3.383 per cent.
C ("Caseine")	2.814 " "	3.129 " "	2.928 " "
A ("Albumen")	0.144 " "	none " "	none " "
P (Soluble)	0.335 " "	0.352 " "	0.253 " "

Of course the total albuminoids must have been the same in amount in each case, but the formation of the skin on the cooked

milk by making it difficult to obtain a homogeneous sample, introduced slight discrepancies in the analyses.

I have put the name albumen in quotation marks, because while similar to the albumen of some authors, the precipitate obtained in this manner would not exactly correspond. Raising the temperature merely to the boiling point is not sufficient. Some albumen is still obtained on boiling the acid filtrate from the casein—the heating must be continued for some time.

Inasmuch as gastric digestion is performed in an acid medium, and precipitation would at once occur, the more complete precipitation of the albuminoid matter in cooked as compared with raw milk would exert a corresponding influence.

The ratio of C to A and P appears to be very variable.

In another sample of milk obtained from the same dairy  $C=2.713$  ;  $A=0.464$  ;  $P=0.332$  :  $Total=3.519$ . This gives a ratio of total albuminoids to casein of 100 : 77. The above sample of sterilized milk gives for the same ratio 100 : 89. It is important to note that a like change is produced in the condensation of milk for canning. Though the heating is carried on in vacuo, yet it is sufficient to raise the percentage of the albuminoids precipitable by dilute acid in the cold very notably. If the heating is continued long enough and is sufficiently raised to render the canned milk entirely sterile, the effect above noted is very evident. Thus in a sample of “sterilized condensed Swiss milk,” the total albuminoids were 10.599% and the casein 9.81% giving the ratio of 100 : 93.

Plate cultures of this condensed milk showed it to be entirely sterile, no bacteria colonies appearing when the plates were kept many days. And it is not surprising that this condensed milk is rendered absolutely sterile, when another evidence of prolonged heating is considered, which is the brownish color. Laboratory experiments upon the sterilization of milk in a steam bath showed that no change of color took place at the end of one hour, an hour and a half or two hours. At the end of three hours the change was perceptible and in six hours the sterilized milk had become strongly brownish-yellow resembling an infusion of coffee to which a large amount of milk has been added. Polariscopic determina-

tions were made of the amount of milk-sugar present after each heating, the raw milk containing 4.18 per cent. No change could certainly be estimated until the end of the six hours period when the percentage had fallen to 3.94, and it then steadily diminished until at the end of 48 hours the milk-sugar had entirely disappeared. There was a corresponding change of taste and color, the former acquiring more and more of that peculiar sweet and bitter flavor perceptible in boiled milk, and which I am inclined to attribute to the change of the milk-sugar, and the color at the same time becoming of a dark brownish-yellow. The decomposition product of the milk-sugar is the chief substance concerned in the development of the brown color, but not entirely since the mixture of casein and albumen separated from such heated milk and treated with ether to remove all the fat, has on drying, a strong yellow color. The casein obtained in a similar manner from raw milk dried perfectly white, and the albumen is white also. The fact that the albumen by heating becomes precipitable by dilute acid is one evidence of its change of character, and that on drying this changed albumen becomes yellow is another evidence.

The decomposition of milk-sugar is attended with the development of an acid, probably glucic acid. Filtered off from the insoluble substances left after heating for 48 hours, the solution which no longer contained any milk-sugar, had a brown color and acidity thus developed from 100 cubic centimetres of milk was equivalent to 13.8 cubic centimetres of decinormal soda.

It may justly be objected that such great changes as the entire destruction of the milk-sugar are never met with in the condensed sterilized milk of commerce, or in commercially or privately sterilized milk. The objection while true, does not apply to the object which I had in view which was to carry the experiments far enough to find out what was the nature of the substances formed.

That the process of heating to prepare the sterilized condensed milks of commerce is not carried far enough to perceptibly lower their percentage of milk sugar may be seen from the following analyses of an American and a Swiss preparation. The American



had a slight tint, the foreign was distinctly brownish. The condensation in both cases had been carried to such a point that the crystals of milk-sugar had begun to separate, the admixture of water bringing out a distinctly granular appearance due, as the microscope also showed, to minute crystals of milk-sugar. I give the composition of the American variety when diluted with  $2\frac{1}{2}$  times its volume of water ; when diluted to such a point that its total solids amounted to 13.4% (this being about the average total solids in our ordinary whole commercial milk); and the composition of the original condensed milk. The Swiss variety is similarly tabulated except that it was diluted for purposes of analysis with only twice its volume of water. The advertisements accompanying the samples stated that when diluted as above, each would have the strength of rich table milk. But such is not the case, and a commercial milk, if prepared from them by diluting to point recommended, would be condemned by an inspector as adulterated milk.

AMERICAN CONDENSED MILK.			
	$2\frac{1}{2}$ times diluted.	Normal.	Original.
Milk-sugar	3.295	4.843	12.37
Fats	2.625	3.859	9.18
Total Albuminoids	2.647	3.890	8.26
(Caseine	1.906	2.802	)
Ash	0.546	0.802	1.91
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Total Solids	9.113	13.394	31.72

SWISS "CONDENSED, STERILIZED CREAM MILK."			
	2 times diluted.	Normal.	Original.
Milk-sugar	4.527	4.866	13.581
Total Albuminoids	3.506	3.798	10.599
(Caseine	3.27	3.515	9.81)
Fats	3.714	3.992	11.142
Ash	0.688	0.738	2.064
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Total Solids	12.435	13.394	37.386

It is surprising that the composition of two milks, as may be seen from an inspection of the column marked "Normal," should be so strikingly similar when we consider that the cattle fed on the Swiss alps, and in the Western State, from which this American sample came, were of different breed, and that their feeding, care, etc., were also widely diverse. By carrying the condensation to a farther point and by more prolonged heating, the Swiss variety was made of a slightly brown color. But both were sterile and when, the cans having been opened, diluted milk was allowed to stand in flasks loosely stoppered with cotton wool, the contents of both cans and flasks soured and spoiled very slowly.

Condensed milk properly prepared is, in fact, sterilized milk in a concentrated, convenient and portable form. It is important to compare it with sterilized milk, prepared and sold in sterilized flasks, but without condensation. One of these preparations is stated to have been prepared from the milk of registered Jersey cattle, and to be especially adapted for use by infants, children, invalids and travelers.

The advertisements state that no alterations have been in the composition of the milk, and that the only manipulation which it has undergone is that of immediate transfer to glass bottles suitably stoppered, followed by sterilization with the heat of a water bath. The temperature of the bath is not stated, nor the length of time in which the bottles are immersed, but the heat is said to be adequate to destroy all the germs of fermentation, and that samples opened after six months have shown no change.

The advantages claimed for this sterilized milk are its preparation from the fresh milk before any opportunity of absorption of any considerable number of microbes; that in the brief interval between the milking and the sterilizing there is no time for the development of spores; that it easily made such a close copy of nature's nourishment that only really good breast milk is its equal; that it does not curd in solid masses, but like breast milk in small soft flakes.

In addition, the statement is made that the Jersey milk is richer in the elements needed for bone and tissue building than the milk of any other breed; that it yields an adequate and guar-

anteed proportion of cream, averaging 25 %, and that when diluted with an equal volume of boiled water the "cheesy element" is reduced to a proper proportion.

Samples of this commercial sterilized milk obtained in midsummer exhibited a separation of the fats in masses of considerable size. By moderate warming and shaking this fat could be partially diffused through the milk, but not in such a manner as to bring the sterilized milk back to the ordinary appearance of rich milk, or milk on which the cream has risen on standing and then has been shaken up again with the milk. Samples which were obtained later in the year, December, did not present this appearance, but resembled rich milk, and the separation of the fat in the former case was probably due to the samples having been kept in my laboratory for several weeks during very hot weather. The reaction was neutral. Cultures were made with gelatine peptone in the ordinary manner, but no growths were obtained, showing that sufficient heat and time had been given to render the milk entirely sterile.

The composition of one of the midsummer samples was as follows :

Total Solids determined directly .....	14.05%
Water .....	85.95

Constituents separately determined :

Fats .....	5.26
Albuminoids .....	3.92
Milk-sugar .....	4.26
Ash .....	0.726

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Sum of constituents so determined ..... 14.166

A midwinter sample (Dec. 12th) exhibited the following composition :

Total Solids determined directly .....	14.70%
Water .....	85.30

## Constituents separately determined :

Fats .....	5.36
Albuminoids .....	3.92
Milk-sugar .....	4.62
Ash .....	0.79
	<hr/>
	14.69

Both of these samples were sterile. The most striking feature is their high percentage of solids, and especially of fat, as might be anticipated from the statement as to the source of the milk. Milk containing a large percentage of fat is valuable for its butter-making qualities, but its advantages as a nutrient are open to question. Thus Uffelman (*Archiv. für die gesammte Physiologie*, Vol. 29, p. 339), states, as the result of his experiments, that the milk-sugar is the constituent most completely used up in the process of digestion, the albumenoids following next, then the fat and finally the salts.

As to the apparatus used in sterilization I have employed the ordinary steam bath, which is a part of the usual Koch biological outfit, but the Arnold steamer made and sold for milk-sterilization expressly, is more convenient and satisfactory. The flasks were closed by the rubber stoppers recommended by Soxhlet, with a glass rod passing down through a hole in the center. But in the infant ward of the Philadelphia Hospital, the sterilized milk is heated in flasks loosely plugged with cotton wool and placed in a bath of boiling water, and this arrangement is entirely satisfactory when the milk is to be used on the spot.

As to the number and character of the bacteria present in commercial milk, it is not necessary to my present purpose to speak at great length. Five samples purchased for me at the most untidy shops, in the poorest quarters of Jersey City, yielded after 36 hours culture 33600, 42000, 24720; 5832, and 154 colonies. The smallest numbers were obtained in the last two samples which were the richer milks having a yellowish-white color, while the other three were poor white milk.

Very interesting in this connection are the results obtained by the examination of the milk obtained from cows fed on brewers'

grains, and a mixture of grains and swill. An analysis of the brewers' grains showed that they were rich in albuminoids, and in so far contained a large amount of material available for nutrition. Two samples were analyzed :

	I.	II.
Water.....	74.81 per cent.	75.75 per cent.
Ash.....	1.25 “ “	0.851 “ “
Albuminoids.....	6.26 “ “	5.807 “ “

Or, calculated on the grains after drying :

Ash.....	4.97 per cent.	3.51 per cent.
Albuminoids.....	24.45 “ “	23.95 “ “

The first were fed to cattle affording the milk analysed under column I a; the second, together with some swill, affording milk II b. Eleven cows were fed in the first case in a small stable, very dirty, without bedding. The udders were very dirty, but apparently without sores.

The cows had been driven into the stalls and secured by causing their heads to pass through a vertical slit, allowing of an up and down motion, and were to be kept there until their udders should dry up. Their food appeared to be passing through them with a constant fluid diarrhoeal discharge. The milk had an alkaline reaction, and a peculiar taste.

In the second case the milk had an exceedingly disagreeable, repulsive taste, a slight butyric odor and a strongly alkaline reaction. In fact, the taste gave rise to the impression that soda had been surreptitiously introduced into the milk, without attracting the notice of the inspector who obtained these samples for me. The composition was as follows :

	I a.	II b.
Fats.....	3.92	2.89
Total Albuminoids ..	4.29	4.26
(Caseine .....	2.74	2.32)
(Albumen .....	1.55	1.94)
Milk-sugar.....	4.18	3.04
Ash.....	0.748	0.839
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Total Solids.....	13.138	11.029

The ratio of ~~the~~ albuminous to the caseinous matters is abnormally high, as if due ~~to~~ the feeding with so large an amount of soluble nitrogenous matter. In the second sample the percentage of fats are abnormally low.

The first milk after 60 hours culture yielded 874 colonies per cubic centimetre; the latter 6500 colonies. After being heated for 15 minutes in the sterilizer, counting from the time when its inside temperature had reached 100° C., the latter milk had become sterile, yielding no colonies on culture.

As to the length of time to which milk should in general be kept at the temperature of boiling water in order to sterilize it, I am inclined to believe that the period of one hour usually recommended, is excessive. The experiments previously detailed show that as soon as the temperature of milk reached the boiling point, most of the "albumen" is so changed that it becomes precipitable in the cold by dilute acid, and even heating less than half-hour to 100° C., is sufficient to change the whole of it. The remaining albuminoids in milk are similar in their nature to peptones and are not precipitate by dilute acid or by boiling. But the bacteria are made up largely of albuminoids similar to the first two classes of bodies referred to and not to the last, and the probability of their escaping devitalization after half an hour's boiling is primarily not great. In fact experiments have shown that in the great majority of instances the sterilization is complete in a half hour or less time, and for this reason the prolongation of heating to an hour, with its attendant inconveniences, is in general an unnecessary precaution.

My thanks are due to Mr. Geo. W. McGuire, the State Dairy Commissioner of New Jersey, and to my assistant, Mr. Wm. G. Johnston, for their aid in the performance of the experiments detailed in this article.

# ON THE NECESSITY FOR THE SYSTEMATIC INSPECTION OF WELLS IN CITIES AND TOWNS.

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BY DURAND WOODMAN, PH. D.

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In presenting the following analytical data obtained from an examination of wells in Newark, N. J., it may be remarked that the case under consideration is not a special one, but illustrates conditions which not only exist to-day in many cities and towns, but which are constantly reappearing whenever a new centre of population forms, and are always a fit subject for more stringent and systematic sanitary regulation than that to which they are usually subjected.

Newark presents the usual case of the growth of a city where the water supply from wells has long been superseded by an aqueduct service, except among the small minority who still persist in the use of wells, either through force of habit and old association, motives of economy, convenience, or sometimes among the poor, inability to have the city water close at hand, and occasionally through distrust of the aqueduct supply.

Many wells in a town become unfit for use before the introduction of a general system of water distribution, and sickness caused by them, or the impending danger of epidemics lead to the agitation which results in a change. But after the new supply is provided all interest in wells subsides; each well owner continues to use well water as long as he pleases, or until the family physician insists on its discontinuance. When a particular season develops an epidemic the Board of Health is aroused and many old wells are examined and closed; many more remain to cause future trouble.

An examination of over thirty wells in Newark, selected in as many different localities as possible, disclosed some very astonishing cases of badly contaminated water in daily use.

Referring to the tabular statement of analytical results, the first sample taken for comparison is water from the Passaic River, opposite the outlet of the Millbrook sewer, which, if not as bad as that much defiled river can furnish, is at least very much worse than any water ever drawn from a faucet in the city.

The first well water examined contained nearly twice as much free ammonia (.049 parts per 100,000) as this river sample, and had almost as bad an odor after standing a few hours. The second well, No. 224, a street pump only a block distant from the preceding, contains but .005 parts per 100,000 *total* ammonia, and would be rated a good water, while third, No. 227, is again an aggravated case. Free ammonia, .068 parts per 100,000.

Continuing, it will be found that fifteen out of thirty-two here tabulated are unfit for use, being contaminated in several instances to an extent which makes it seem almost impossible that they should be found tolerable.

Only one of the fifteen No. 297 contains less free ammonia than the sewer outlet sample. Of two of the fifteen it was stated by those living on the premises that the water was unfit to drink; but nothing had been done to prevent water being drawn from them by any one who chose to do so.

No. 245 containing .068 parts per 100,000 free ammonia and other conditions corresponding (see Table) was said to be "used only in hot weather."

#### FREE AND ALBUMINOID AMMONIA.

Referring to the table, it will be noticed that all the waters are characterized by a large proportion of free ammonia, which in No. 326 reaches the extreme figure 0.74 parts per 100,000, and in a well concerning which no warning was given by those on the premises.

The albuminoid ammonia is, in one case only, higher than in the sewer outlet sample or 0.05 parts per 100,000 in No. 284. This water was filled with minute green particles of a species of algae, imparting a greenish tinge to the entire mass.

#### CHLORINE.

It is well known that the value of the chlorine determination is relative only and taken alone, without a knowledge of the quantity



natural to waters of the locality in question, is likely to be very misleading.

A comparison of results in the chlorine column shows the want of uniform agreement between the evidence furnished by the amounts of chlorine and of ammonia.

The lowest chlorine is in No. 278, a water which at least would be called doubtful judged by the ammonia determinations, while in No. 358 a well on high ground with an abundant supply of water from the sandstone rock three times as much chlorine is found. (2.63.)

The same well also contains more chlorine than the river sample from opposite the sewer outlet.

No. 227, a very bad water, irrespective of chlorine, contains 5.07 parts per 100,000.

No. 271, in which free ammonia is only .003 and albuminoid ammonia only .007 parts per 100,000, contains 9.36 parts chlorine per 100,000 or nearly twice as much.

No. 290, an offensively bad water, is comparatively low in chlorine (3.22 parts per 100,000), while No. 281, a comparatively good water, contains nearly twice as much. (5.82 parts.)

No. 245, a very bad water, contains 4.38 parts per 100,000 chlorine, while No. 326 containing over ten times as much free ammonia, contains only 2.5 as much chlorine. (11.40)

Again, the first three wells, which are in the same neighborhood, yield almost precisely the same quantities of chlorine, while the ammonia varies from a very low figure in No. 224 to .049 in No. 217.

From these results it appears that a large proportion of chlorine is a normal characteristic of much of the water from wells in the level and lower part of the city, and also that it varies greatly. This level consists of gravel or "drift" and is about 30 feet above mean tide. An estimation of the chlorine contained in it gave the following result:

1,360 grams taken at a depth of seventeen feet and away from any source of contamination yielded 4.17 grams chlorine.

$$\frac{4.17 \times 100}{1360} = 0.306 \text{ per cent.}$$

or from ten to fifteen times as much as found ordinarily in earth at points distant from tidal ways. (The average of 21 determinations, U. S. Agricultural Report, 1885, p. 175, is 0.02 per cent.).

#### TEMPERATURE.

The temperature observations were made as a means of judging approximately, in cases when direct observation was impossible, as to whether the well was very shallow or affected to any great extent by surface drainage.

The temperature of deep seated springs corresponds very closely with the mean annual temperature of the locality, which, in the case of Newark, N. J., is  $50.52^{\circ}$  F.

In about two-thirds of the observations recorded the approximation to this figure is very close.

That of No. 358 observed at the end of the Summer (Sept. 10th) is  $51.5^{\circ}$  or one degree higher than the mean annual temperature.

The lowest recorded temperature  $48^{\circ}$  happens to be in a very shallow well, No 276, but this well is nothing more than the outflow of a vigorous spring which rises to within ten feet of the surface. (Observation made May 16th.)

#### DISTANCES FROM CONTAMINATING SOURCES.

Even among people otherwise well informed the notions as to safe distance between a well and a cesspool or privy vault seem to be vague to the extent of allowing them to take great risks.

In most of the cases here given in the column of distances between wells and vaults, probably no special thought or anxiety was ever expended. Each one has looked out for himself according to his own ideas, regardless of neighbors. Eight and ten feet are among the most striking figures giving evidence of the popular confidence in the filtering and purifying influences of limited thicknesses of earth, while the analytical results show to what extent such confidence is misplaced.

The question so frequently asked of the chemist, "How far distant from cesspool and privy vault must a well be placed to be safe?" is of course one that does not admit of a general answer;

for the kind of soil, rock, etc., in which the well is sunk, the direction in which drainage tends, and other variable conditions necessarily make each case a subject for special inquiry.

#### NEED OF INSPECTION.

The conditions shown to exist by the foregoing seem in some instances almost incredible and prove without argument the necessity for systematic inspection to prevent the existence of wells in such a state as those described, many of which like the one previously referred to, are reserved for use in Summer weather.

Boards of Health of cities and towns should have complete lists of the wells in actual or possible use, an analysis of each sufficient to determine the character of the water, with particulars as to location and surroundings.

Annual inspection would result in closing such as were found to be approaching the limits of safety, while those showing no deterioration could remain in use.

In accordance with the results of such inspection well owners should be given a preliminary notice that the further use of the well is dangerous, naming a time limit, at the expiration of which, if not closed by the owner, it will be closed by authority of the Board of Health, at the same time posting a notice on the well house or pump stating that the water is unsafe to drink.

This allows opportunity for new arrangements to be made, if any are necessary, and prevents the ill feeling and opposition which summary proceedings always engender.

From one point of view, viz : the average conditions of proximity to sources of contamination, it would seem that the closing of all the wells herein described would be the only safe plan, and without proper inspection it most certainly would ; but in some cases wells receive an abundant supply of deep spring water coming from considerable and safe distances through strata of the underlying rock, and such wells overflow, so to speak, through the adjacent soil instead of acting as centers of local drainage.

All these questions, however, would be decided from the records of inspection and proper action taken accordingly. When it is considered to what extent an epidemic may be spread through

the medium of bad wells before the means are discovered, nothing need be said to emphasize the risk and danger of allowing the existence of even one well such as nearly fifty per cent. of those described have been shown to be.

**TABULATED RESULTS OF EXAM**

No.	Date.	Tempera- ture F.	Approxi- mate Depth.	Distance from Privy Vaults.	Color or Appearance	Odor.
215	Apr. 28	....	.....	.....	Brown	Soapy.
217	" 29	49°	33 ft.	40 ft.	Slight Opalescence	Soapy.
224	" 29	....	.....	.....	Clear.	.....
227	May 2	49°	.....	{ 25 ft. 27 "	"	{ Offensive on standing.
229	" 2	55°	40 ft.	25 "	"	.....
232	" 3	49°	30 "	15 "	"	.....
237	" 4	55°	50 "	35 " 75 "	"	.....
245	" 11	50°	40 "	25 "	"	.....
247	" 13	50°	?	25 "	Opalescent.	.....
260	" 12	50°	30 "	17 "	Clear.	.....
268	" 14	51°	40 "	32 "	"	.....
271	" 16	51°	.....	{ 25 " 25 " 30 "	Good.	.....
273	" 16	54°	.....	{ 20 " 25 "	"	.....
276	" 16	48°	18 ft.	30 "	Yellowish. (Iron.)	.....
278	" 16	58°	28 "	18 "	Clear.	.....
281	June 18	54°	30 "	25 "	"	.....
284	" 20	54°	.....	8 "	Greenish Yellow.	Offensive on standing.
287	" 20	53°	.....	{ 30 " 35 "	Clear.	.....
290	" 21	56°	.....	25 "	Clear.	Offensive on standing.
293	" 21	53°	33 ft.	{ 25 " 30 "	Turbid.	.....
297	" 21	53°	35 "	(6) 40-80 "	Excellent.	Earthy.
318	" 22	52°	.....	.....	"	.....
320	" 22	53°	.....	45 ft.	"	.....
323	" 27	54°	.....	.....	"	.....
326	" 27	57°	...	{ 10 ft. 25 " 30 "	"	.....
330	" 28	52°	25 ft.	40 "	Yellowish Opalescence	Offensive on standing.
333	" 28	52.5	30 "	.....	Clear.	.....
336	" 28	56°	.....	25 ft.	"	.....
340	" 29	55°	35 ft.	20 "	"	.....
357	July 29	54.5	.....	30 "	"	Offensive.
358	Sept. 10	51.5	55 ft.	30 " Water-tight	"	.....
423	.....	....	70 " piped.	30 ft. Sewer.	"	.....

# OF WELLS IN NEWARK, N. J.

Parts per 100,000.

Free.	ANIONIC.		Hardness.	REMARKS.
	Alum.- equiv.	Chloride.		
0.026	0.045	1.90	2.44	Pasanic River, opposite outlet to Millbrook Sewer. Tide going out.
.049	.006	5.20	17.90	Chain and Buckets.
Total	0.005	5.50	.....	Wooden pump. Edge of sidewalk.
0.000	.....	5.07	26.81	Pump.
.005	.004	10.55	21.40	
.001	.009	9.09	19.20	
.083	.010	12.24	16.00	
.006	.004	4.28	10.67	" Only used in hot weather."
.192	.010	10.54	18.07	
.099	.009	11.20	27.22	
.004	.006	5.85	18.06	" Used in Summer."
.000	.007	9.26	5.60	Wooden pump.
.011	.007	.....	.....	Pump 150 ft. from Morris Canal.
.005	.006	5.12	16.73	
.008	.007	0.88	5.54	
.009	.009	5.82	15.16	Wooden pump.
.027	.050	19.75	49.50	" "
.074	.017	17.05	18.44	" "
.055	.024	3.22	12.00	Pump. Said to be unfit to drink.
.002	.007	5.24	10.67	Brick lined well.
.017	.017	18.26	26.53	
.001	.005	3.88	11.90	Pump.
.005	.004	6.95	8.22	Wooden pump.
.149	.009	7.31	16.66	
.739	.....	11.00	12.26	Pump.
.325	.006	8.70	9.73	
.002	.012	.....	.....	Wooden pump.
.002	.005	3.73	15.12	Pump.
.002	.019	6.44	11.90	
.7206	.002	12.00	8.26	Pump.
.0002	.012	2.60	.....	
.0002	.012	11.00	26.00	Iron pump.

## EXPERIMENTS ON MILK ANALYSIS.

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BY E. WALLER, PH. D.

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Legislation regarding food adulteration has been frequent since mediæval times. The most decided step of general importance in English speaking countries however was the act of the English Parliament in 1872, under which, I believe, for the first time, the office of Public Analyst was created. That act has been modified by more recent ones, but the important and essential features have been retained. With the establishment of the office of Public Analyst the formation of a society of Public Analysts for mutual benefit and information naturally followed in the Autumn of 1874 (*Chemical News*, 31, 58).

The Society at its very inception came to an agreement as to the standards or percentages of the component parts of several of the commonest articles of food, among them milk. The limits were set in the following terms, (*loc. cit.*), "milk shall contain not less than 9.0 per cent., by weight, of solids not fat, and not less than 2.5 per cent. butter fat."

The method of analysis was not, so far as I am aware, officially described, but apparently by a general, informal understanding, the method described by Wanklyn in his book on Milk Analysis (London, 1871) was generally adopted with the exception that the portion taken for analysis (usually 5 grms.) was weighed instead of measured as he recommends. The method consisted in drying this quantity of milk in a weighed dish over the water-bath for 3 hours, weighing to determine the water by loss, and then extracting the milk solids three times with boiling ether, decanting through a filter, evaporating the ether and weighing the fat. Previous to the formation of the Society of Public Analysts I had experimented on Wanklyn's method and had adopted a modification of it, known on this side of the water as the Wanklyn-Waller

method. The modifications consisted in finishing the drying in an air bath at  $100^{\circ}$  to constant weight, in increasing the number of applications of ether to six or more, and in checking the determination of butter fat by drying and weighing the exhausted milk solids. The filtration of the ethereal solution of fat was also dispensed with as unnecessary, (*Analyst* 9, 69, and *Cairn's Quant. Analysis, New Edition, p. 204*). About the beginning of 1884 the British Society of Public Analysts appointed a committee to investigate methods of milk analysis, and to report a method which should be recommended by the society. While this committee was still occupied with its labors, Mr. M. W. Adams brought up his method, which (*Chemical News*, 10, 46) consisted in absorbing the 5 grms. of milk taken for analysis into a paper coil, drying off and determining the water by loss, and then extracting the fat from the coil by means of an extractor of the Soxhlet pattern. This method gives a higher figure for the fat, and after trial was recommended by the committee as the method for fat.

But one additional point in the procedure has been adopted since that time, viz., the previous extraction of the coil with alcohol containing 10 per cent. of glacial acetic acid, followed by an ether extraction, to prepare it for use. The "limits" previously set by the society were also modified in consequence, that for solids not fat being put at 8.5 and for butter fat at 3 per cent., practically an assertion that by the Adams method 0.5 per cent. additional fat was obtained.

In the meantime, in the United States, the National Board of Trade offered in 1880 a prize for an essay on food adulteration, to be accompanied by the draft of an act to be recommended to our legislators. The prize was given to G. W. Wigner, a prominent member of the British Society of Public Analysts, and legislation followed.

Also, in 1884, the New York legislature passed an act creating a State Dairy Commissioner, and legal limits were fixed for the composition of milk which should be merchantable.

The act declared that whole milk should contain at least 12 per cent. of solids, of which 3 per cent. should be fat. Some other States have also passed similar laws. The New Jersey standard



was, I believe, the same as that in New York; that of Massachusetts called for 13 per cent. of solids.

In consequence, the question has often been put in court, not "Is it your opinion, as an expert, that the milk in question was skimmed?" but, "Did this milk contain less than 3 per cent. of butter fat?"—a distinction in which there was sometimes a great difference. When a case was brought into court in which between 2.5 and 3 per cent. of fat had been found by the Wanklyn-Waller method, the counsel for the defense has claimed that since, by the Adams method 0.5 per cent. of fat more was attainable, his client must therefore be regarded as innocent. A logical consequence of this reasoning, would, however be, that as the law had been framed in the light of results obtained by the W-W. method, that 3.5 per cent. of fat should be demanded, and that his client, on the face of the facts, could not be regarded as innocent.

The correctness of the results by the Adams method, is, however doubted by many chemists.\*

Some investigations by the writer as to the comparative value of results by the two methods mentioned may therefore be of interest. The milks examined are designated as follows:

	Per cent. water.	Per cent. ash.
A. Certified as genuine.....	87.29	0.769
B.     "                 ".....	88.03	0.723
C.     "                 ".....	86.49	0.763
D.     "                 ".....	86.94	0.797
E. Suspected sample.....	87.23	0.698
F.     "                 ".....	88.86	0.695
G.     "                 ".....	87.47	0.745
H. Purchased for experiment .....	87.596	
I. Sample H diluted with two volumes of water.	95.963	
J. Cream from H.....	77.866	
K. Skim from H.....	88.668	

E. and F. were analyzed by other chemists in New York, in the regular course of business, and not as checks on this work. The

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\* Wanklyn, *Chem. News*, 53, 70.

Review of "Wanklyn's Milk Analysis," new edition. *Chem. News*. 53, 213, Johnstone. *Chem. News* 60, 233 and 257.

gentlemen, however, kindly permit me to quote their results (marked X.)

As a part of the investigation, the influence of the size and shape of the dishes used in the W-W. method was tested; the respective merits of the round (hemispherical) bottomed dishes, (recommended by Wanklyn) and of flat bottomed dishes was noted. The classes of dishes used were:

Designation.	Capacity.	Bottom.	Approximate diam. of
O		Flat	2 $\frac{3}{4}$ inches
L		"	2 $\frac{1}{2}$ "
S	$\frac{1}{2}$ oz.	Rounded	1 $\frac{1}{4}$ "
V	1 oz.	"	1 $\frac{1}{2}$ "
R	2 oz.	"	2 "
M	6 oz.	"	2 $\frac{1}{4}$ "

Some of these dishes, when containing milk solids, were subjected to continuous extraction (marked "Con" in the Table). Mr. E. W. Martin, of the New York City Health Department, has devised a form of extractor which can be used with a platinum dish which I have here for inspection. It consists simply of a flask with a chamber above of sufficient size to accommodate the dish, which is surmounted by a worm condenser, the whole of glass, put together with ground joints. In the side of the dish is a hole through which can be passed a glass tube, suitably bent to form a syphon, by which means the intermittent flow of the ether, common to all extractors of the Soxhlet pattern is secured.

This apparatus was used where in the Table dish "O" with continuous extraction is specified.

Mr. Martin also suggested the use of tinned lead capsules (such as are used for making bottle caps) in which to evaporate the milk solids. When it may be desired to subject them to continuous extraction, they may be pinched together and inserted in the tube of an ordinary extractor. Such dishes are designated in the Table as "L."

FAT								
No.	Method.	Dish.	One Extraction.		Two Extractions.		Three Extractions.	
			Direct.	By Loss.	Direct.	By Loss.	Direct.	By Loss.
A	W-W. con.	O	3.972	3.740	4.081	3.987	4.091	3.943
"	W-W.	S	3.628	3.531	3.721	3.727	3.746	3.748
"	"	R	3.854	3.741		3.798		
"	Adams.		4.240		4.267			
"	"		4.339		4.563			
"	"		†4.124					
B	W-W.	S	2.857	2.900	3.073	2.963	3.089	3.098
"	"	V	2.977	2.905	3.049	2.969	3.081	3.054
"	"	M	3.387	3.100	3.265	3.041		
"	Adams.		3.277		3.283			
"	"		3.407					
C	W-W con.	O	4.244	4.111	4.284	4.181		
"	W-W.		3.996	3.893	4.244	4.061	4.274	4.153
"	Adams.		4.440		4.467			
"	"		4.458		4.518			
D	W-W. con.	L	4.215	3.748				
"	W-W. con.†	L	4.000	4.319				
"	W-W.	V	3.728	3.748	3.907	3.907	3.967	3.957
"	W-W.	M	3.686	3.686	3.855	3.825	3.894	3.866
"	Adams.		4.184					
"	"		4.258					
E	W-W.	V	4.721	4.572	4.885			
"	W-W. con.	O	5.133	4.780				
"	Adams.		4.960		4.989			
"	"		5.015		5.025			
"	"		†5.151					
"	"		†4.904					
"	"	X	5.030					
F	W-W.	R	2.800	2.700	2.867	2.827		
"	"		2.817	2.837	2.877	2.906		
"	W-W. con. X	O	3.070	3.080				
"	Adams. X		3.320					
G	W-W.	I.	3.146	3.221	3.288	3.416		
"	"	I.	3.057	3.028	3.315	3.340		
"	Adams.		3.823		3.823			
"	"		3.812		3.822			
H	W-W.	L	3.439	3.334	3.497	3.641		
"	Adams.		3.858					
I	W-W.	L	1.188	1.179	1.228	1.218		
"	Adams.		1.450					
J	W-W.	L	14.561	14.592	14.636	14.679		
"	Adams.		14.511					
K	W-W.	L	2.358	2.352	2.424	2.468		
"	Adams.		2.731					

\*Extracted through bone black

†Treated as prescribed by Wanklyn. Water driven off by drying for three hours on the water bath only

Samples E to K inclusive, were used for another test upon the relative action of the two methods, as will be detailed later.

In the table by an "extraction" is meant the ordinary degree of extraction usually given in the respective methods, viz., five or six applications of ether in the W-W. method, except when marked "*con.*" In these cases and with the Adams method twelve or more syphonings of the ether occurred. It will be seen that the W-W. method, as a rule, gives results 0.2 to 0.3 per cent. less than the Adams method, and not 0.5 per cent.

#### CHARACTER OF THE FAT.

The difference in odor between the fat obtained by the two methods was noted by many when the method was first published and tried. No other differences have, however, been pointed out. Tests were made on several of the lots of fat extracted. Though incomplete, the indication seems to be that some material not fat is extracted with the last portions of the fat. Whether it is extracted in sufficient quantity to affect the weight to the extent of difference noted between the two processes, cannot be confidently asserted.

One way of testing was as follows: To the fat from 5 grms. of milk was added about 25 c.c. of hot water and a drop or two of ammonia. After warming for about 15 minutes this was filtered, and the filtrate evaporated until the alkalinity was quite faint. It was then filtered, cooled, and tested with a drop of nitric acid, and one or two of strong mercuric nitrate solution, or with potassium ferrocyanide acidified with acetic acid. The fat obtained by the Adams method usually showed precipitates in this case, which suggested the presence of albuminoids, while that from the W.-W. method showed little or no precipitate of the kind, as the degree of extraction was less. Modifications of this treatment such as more or less dilution, more or less ammonia, or more or less heating, gave phenomena other than those described, but with a uniform method of treatment, the fat from the two methods showed different reactions. Fat extracted by the Adams method through bone black (previously exhausted with ether) gave reactions the same in kind, but apparently differing in degree from that obtained in the ordinary way. The difference in proportion (percentage) was practically *nil*.

Attempts were made to determine nitrogen in some of the fats,

but it was apparent that some disturbing influence existed, for which the most rational explanation seemed to be that the paper of the coils had absorbed small amounts of ammonia salts.

Extractions by either method could not be carried to the point where no visible residue was left on evaporating the ether, although it soon reached a point where it was unweighable. That from the W-W. method was fatty in character and appearance, although there appeared usually to be something else with it. That from the Adams method was less uniform in appearance, a portion resembling fat to the eye, but it was sticky to the touch like a soft resin. It was perfectly soluble in ether, and insoluble in water. When a drop of ammonia was added to the water, a partial solution seemed to take place, and it detached itself in white scales, which turned brown with strong ammonia, becoming green on exposure to the air. The weak ammonia solution on boiling up with Fehling solution and standing overnight showed a slight red deposit.

I have made an extractor, put together with ground glass joints throughout, to test thoroughly the question as to whether anything was due to the corks used in the connections. I have as yet had no opportunity to try it.

#### DILUTION AND SKIMMING TESTS.

##### *Samples H to K inclusive.*

To test these methods in another way, some milk was purchased and the specific gravity taken. This was found to be 1.0325. A portion was diluted with exactly two measures of distilled water, and another (weighed) portion was skimmed, and then whole milk, dilution, cream and skim subjected to analysis by both processes. The results have already been given, but for convenience they may be restated.

##### *Dilution.*

MILK.	METHOD.	PER CENT. WATER.	PER CENT. FAT.	
			Direct.	By Loss.
Whole milk H....	W-W	87.596	3.497	3.641
“ “ .....	Adams	“	3.858	
Dilution I.....	W-W	95.963	1.228	1.218
“ .....	Adams	“	1.450	
Calculated by.....	W-W	95.777	1.190	
“ .....	Adams	“	1.313	

It seemed more than probable that the apparent percentage of fat by loss on H was partially due to water unexpelled in the first drying ( $3.631 - 3.497 = 0.144\%$ ). A correction and recalculation on this assumption will of course show no change as to fat, but gives figures for water and solids not fat, more in accord. This would give :

	WATER.	SOLIDS NOT FAT.	
		By WW.	By Adams.
Whole milk H.....	87.740	8.763	8.402
Dilution I.....	95.968	2.809	2.587
Calculation for I.....	95.826	2.910	2.861

The fat in both cases is a little higher than the calculation calls for. In the case of the W.-W. method by 0.038, in the case of the Adams method by 0.137, a result more favorable to the consistency of the first named.

### *Skimming.*

A small stoppered globe with a stopcock below, was weighed first empty and then, after partially filling it with the (well mixed) milk. After allowing it to stand quietly for about three hours, it was again weighed, and then the skim was run off from below, and the globe and cream weighed. The cream was run off into a separate beaker, and after pouring a few times through the globe to insure mixing, the products were analyzed as before. The data obtained were :

Weight of original milk.....	105.0065
After standing three hours.....	105.0020
Weight of cream.....	9.4330
Weight of skim.....	95.5690

### Analysis :

	WATER.		FAT (W-W)		FAT (Adams).
	Actual Result.	Corrected.	Direct.	Loss.	
Cream.....	77.866	77.909	14.636	14.679	14.516
Skim.....	88.668	88.712	2.424	2.468	2.731

Calculation :

	Grms. Sold's.	By W-W.		By Adams.	
		Grms. Fat.	Grms. S. n. f	Grms. Fat.	Grms. S. n. f
In 9.433 grms.					
Cream .....	2.0879	1.3086	0.7073	1.3688	0.7191
In 95.569 grms.					
Skim .....	10.8299	2.3166	8.5133	2.6100	8.2199
Sum .....	12.9178	3.6972	9.2206	3.9788	8.9890
In 105.002 gr's.					
Whole milk ..	13.0224	3.6719	9.3525	4.0510	8.9734

CORRECTED FOR WATER, AS BEFORE.

In 9.443 grms.					
Cream .....	2.0838	1.3086	0.7032	1.3688	0.7150
In 95.596 grms.					
Skim .....	10.7878	2.3166	8.4712	2.6100	8.1778
Sum .....	12.8716	3.6972	9.1744	3.9788	8.8928
In 105.002 gr's.					
Whole .....	12.8732	3.6719	9.2013	4.0510	8.8222

Result by W-W. 0.0253 grms. high.

Result by Adams, 0.0722 grms. low.

With the cream the Adams method gives lower results than the W-W. method. This was evidently due to the selective action of the paper of the coil, it having been found exceedingly difficult to cause it to absorb the cream. The aqueous portion was more readily absorbed.

The W-W. method, though a little higher than calculation as before, gives closer results than the Adams, although by making an allowance for the imperfect absorption of the cream by the coil in the latter case, it would appear that each process is fairly consistent with itself, a result which was not anticipated. It suggests the query whether milk does not contain some constituent slightly or not at all affected when the milk solids are dried in a dish, which is however rendered soluble when the milk is dried on a coil of paper. Wanklyn has suggested a probable change in the albuminoids of the milk induced by drying on the coil.

The conclusions from these experiments may be thus summarized :

1. The determination of butter fat in milk by the Adams, method, does not usually give results 0.5 per cent. higher than by the W-W. method.

2. In the W-W. method more satisfactory results are obtained by extracting a few times with ether, drying and then extracting again, than by extracting without drying between.

3. In either case the extraction of the last portions of the fat appears to remove something not fat. More of this material appears to be removed in the case of the Adams than of the W-W. process.

This material may exist ready formed in the milk, or may be formed by the physical treatment to which the sample is subjected.

4. In the W-W. method, flat bottomed dishes 2 to 2½ inches in diameter give the most satisfactory results.

5. With fairly rich cream, dilution or some similar device is advisable when the Adams' method is used.

6. The determinations of water in milk, are liable to be too low rather than too high.

Finally, attention should be called to the fact that the assertion that milk contains water, butter fat, casein, lactose and salts is only a broad general statement, which leaves out of account the true complexity of substances which undoubtedly exist in that fluid.

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## SOME CHEMICAL PRODUCTS OF BACTERIAL GROWTH, AND THEIR PHYSIOLOGICAL EFFECT.

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For a short time I have been engaged in studying the chemical products formed by the hog cholera and swine plague germs by their growth in artificial culture media, and have succeeded in isolating an albumose and ptomaine from each.

To distinguish the products the names *Sucholotoxin* and *Sucholoalbumin* have been given to the substances from the hog cholera cultures, and *Suplagatoxin* and *Suplagoalbumin*, respectively, from the swine plague cultures.



The albumoses are white, pulverulent substances, soluble with difficulty in water, and precipitated from this solution by absolute alcohol. They can be obtained in crystalline plates by drying over sulphuric acid, *in vacuo*.

The ptomaines are best obtained in the form of the double platinum salts, as the hydrochlorides are difficultly crystallizable. These double salts are very light yellow in color, readily soluble in water, difficult so in alcohol, and appear under the microscope as needle-like crystals. (Specimens of the albumoses and platinum salts were exhibited.)

A subcutaneous injection of a small quantity of these substances is sufficient to produce death in guinea pigs in from 24 to 48 hours.

If, however, a much smaller quantity is injected, and the injection repeated a number of times, the animals are protected from the corresponding disease when communicated by direct inoculation with the germ. In quite a long series of experiments, the check animals invariably died, while the treated ones recovered after inoculation with the germ.

More recently, Dr. W. H. Gray, of Washington, and myself have conducted some experiments upon guinea pigs, and succeeded in producing great resistance and subsequently immunity from diphtheria, by first treating the animals with the chemical products obtained from cultures of the germ.

There is every reason to hope that these results can be turned to practical application in the diseases of both animals and men.

December 31, 1890.

## THE JANUARY MEETING.

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REGULAR MEETING, Jan. 2, 1891.

The meeting was called to order at 8:30 P. M., the President, Prof. G. F. Barker, of the University of Pennsylvania, in the chair.

The minutes of the December meeting were read and accepted.

The minutes of the second general meeting were read, amended, and accepted as amended.

Prof. Breneman, of the Committee of Conference for the Philadelphia meeting, then read the minutes of the conference held for the purpose of discussing ways and means to bring about a more general organization of American chemists.

Mr. Rupp moved that the report of Committee on Conference as read, be referred to the board of directors, and that the committee be discharged with thanks. Carried.

The election of new members being next in order, the following gentlemen were unanimously elected:

Prof. J. W. Baird, Prof. of Chemistry Mass. College of Pharmacy, Boston, Mass.

Mr. Robt. W. Schedler, N. Y. Tartar Co., Brooklyn, N. Y.

L. Meyers Connor, City Chemist, Dallas, Texas.

Wm. D. Phillips, 77 Pine street, New York.

Jerome W. Frank, Standard Varnish Co., 734 E. 14th street, New York.

For associate membership:

J. H. Saville, Thomasville, Ga.

The following names were proposed for membership :

George H. Clapp, 95 Fifth Avenue, Pittsburg, Pa.

Alfred E. Hunt, 95 Fifth Avenue, Pittsburg, Pa.

Mrs. Rachel Lloyd, Ph. D., Prof. Analyt. Chem. Univ. of Nebraska, Lincoln, Neb.

Hudson H. Nicholson, Prof. Chem. Univ. of Nebraska, Lincoln, Neb.

Albert H. Welles, N. Y. Tartar Co.

C. H. White, U. S. Navy Yard, Mare Island, San Francisco, Cal.

The resignations of Messrs. Narcisse Pigeon, Yonkers, N. Y., and C. H. Nichols, New York City, were read and accepted.

A communication from Dr. H. Carrington Bolton, in reference to establishing an *Index Chemicus*, was read and referred to the Board of Directors.

Prof. Breneman read an application from Prof. J. H. Appleton, of Providence, R. I., accompanying an application signed by ten members of the Society residing within the State of Rhode Island, who desired to form a Local Section to have its headquarters in Providence, R. I., and to conduct the business of the State of Rhode Island.

Referred to the Board of Directors.

Mr. Rupp moved that a committee be appointed to consider what action should be taken in recognition of the 50th anniversary of the founding of the London Chemical Society. Carried.

The Chair appointed Messrs. Rupp, Breneman, and McMurtrie as such a committee. There being no further business the meeting was adjourned at 10:45 P. M.

DURAND WOODMAN,  
Recording Secretary.

# REPORT OF THE TREASURER OF THE AMERICAN CHEMICAL SOCIETY.

December 31st, 1890.

<i>Resources.</i>		<i>Liabilities.</i>	
Cash in Trust Co.....	\$95 25	Personal accounts.....	\$301 54
Personal accounts.....	410 46	Dues.....	355 00
Initiation Fees.....	10 00	Initiation Fees.....	20 00
Dues.....	30 00	Subscriptions, Journal.....	11 10
Amer. Chem. Soc.....	141 93		
	<u>\$687 64</u>		<u>\$687 64</u>
<i>Gains.</i>		<i>Losses.</i>	
Special Subscription (New- port).....	\$45 00	Expense Newport meeting, Total.....	\$127 35
Special Subscription ('89)...	50 00	Expenses Phila. (partial)...	40 00
Subscriptions to Journal...	64 90	“ Election.....	33 95
Advertisements.....	136 80	“ General.....	323 01
Extra work, Diagram.....	15 00	“ Revision Const'n.....	51 86
Initiation Fees.....	70 00	“ Premium on Ins. Policy.....	8 75
Dues for 1885.....	5 00	“ Journal.....	1,267 00
“ 1886.....	5 00	Reprints.....	63 20
“ 1887.....	10 00		
“ 1888.....	55 00		
“ 1889.....	110 00		
“ 1890.....	890 00		
“ 1891.....	5 00		
Interest on Trust Co. Bal....	5 48		
Am. Chem. Soc.....	448 03		
	<u>\$1,915 21</u>		<u>\$1,915 21</u>

E. &amp; O. E.

FRANK T. KING, *Treasurer.*

## Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

*Issued January 6, 1891.*

**444,004.**—Salicylate of phenyldimethylpyrazolone. H. Lüttke and L. Scholvien.

Obtained by heating, preferably under pressure, phenylhydrazine, acetyl acetic ether, and methyl salicylic ether in the presence of a halorid hydric acid.

**444,044.**—Welding compound. W. W. Brown and M. C. Reynolds.

Consists of borax, ammonium chloride, potassium ferrocyanide and soapstone.

**444,068.**—Apparatus for making extracts from tan bark. J. Hutchings and W. N. Hutchings.

**444,084.**—Process of enameling photographs and other prints. C. C. F. Brandt.

Consists of celloidine, alcohol and ether.

**444,091.**—Apparatus for the manufacture of gas. L. Stevens.

**444,107.**—Manufacture of sugar. G. Adant.

**444,135.**—Detergent. J. Scharr.

Consists of water, sodium carbonate, potassium carbonate, soap bark, crude turpentine, gum arabic, ammonium chloride, crude petroleum, olein, olive oil, phenol, salicylic acid and camphor.

**444,152.**—Apparatus for treating whiskey. F. Madlener.

**444,187.**—Cleaning composition. D. E. Sumner.

Consists of beef gall, cactus root, soap, sal soda, borax, oil of sassafras and water.

**444,202.**—Process of distilling oil. A. Mason.

**444,203.**—Apparatus for distilling oil. A. Mason.

**444,229.**—Compound for coloring broom corn. R. M. Donovan.

Consists of green aniline, burnt alum, water and sulphuric acid.

**444,300.**—Rotary gas scrubber. W. Mooney.

**444,315.**—Apparatus for the manufacture of lamp black. R. Dreyer.

*(Issued January 13, 1891.)*

**444,483.**—Filter, etc. F. Breyer.

**444,538.**—Blue dye. J. Mohler and C. A. Mayer.

Coloring matters obtained by sulpho-conjugating the new products resulting from the action of the primary aromatic amines on the dyes obtained by the action of the nitroso derivatives of the tertiary aromatic amines on the condensation products of tannin with aniline and its homologues, said coloring matters being scarcely soluble in water, soluble in concentrated sulphuric acid with a cherry red color, and forming with the alkalies with a copper red lustre readily soluble in water and alcohol with a greenish blue color, soluble in concentrated sulphuric acid with a cherry red color.

**444,626.**—Lubricating compound. W. Brinck.

Prepared by the action of mineral oils on finely divided caoutchouc at ordinary temperature.

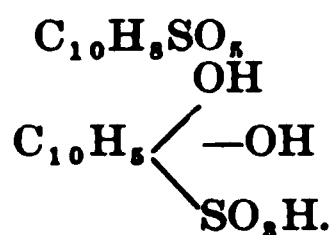
**444,665.**—Anti-fouling paint. N. B. Denny's.

Consists of zinc sulphate, mercuric sulphate, ferric oxide, cupric oxide, zinc slag, zinc, solution of tannin, and shellac varnish.

**444,679.**—Dioxynaphthaline-mono-sulphonic acid. M. Ulrich.

A new dioxynaphthaline-mono-sulphonic acid or its salts produced by melting the salts of alpha-naphthol, alpha-disulphonic acid S, with caustic alkali in a closed or an open vessel.

It has the following properties: the soda salt crystallizes in small white leaves which are easily soluble in water or alcohol of 60% ; by adding ferric chloride to an aqueous solution a dirty green precipitate, and with some drops of calcium hypochlorite a changeable green solution is formed, the latter being decolorized by an excess ; the new acid or its salts give with diazobenzene a new azo-dye stuff, similar in shade to acid magenta, and with ortho-tetrazo-ditolyl or tetrazodiphenyl ethers direct-dyeing coloring matters of bright blue shades. The chemical formula of the acid is:



**444,704.**—Apparatus for distilling wood. A. Koch.

**444,772.**—Apparatus for purifying water. W. Anderson.

**444,775.**—Process of manufacturing artificial ivory. A. de Pont and S. de Pont.

An aqueous solution of phosphoric acid is added to lime, and the resulting phosphate is mixed with finely divided earthy mineral matters, and gelatin and albumin. The mass is then dried and subjected to great pressure while hot.

**444,776.**—Compound for calcimine. G. A. Casselman.

Consists of whiting, marble dust, gypsum rock, borax, zinc sulphate, alum and glue.

*Issued January 20th, 1891.*

**444,833.**—Apparatus for refining oil. B. N. Hawes.

**444,842.**—Paint. N. J. Mitchell.

Consists of coal tar, yellow ochre, plumbago, lime, salt and coal oil.

**444,997.**—Process of treating zinc ores. W. West.

Consists in roasting the ore to form sulphurous acid gas and oxidize the zinc, then cooling this gas to a temperature of 180° F. or below, and passing the same in gaseous form in conjunction with steam and without oxidation into sulphuric acid and through a previously roasted charge to form soluble sulphite of zinc, and then immediately leaching out the zinc sulphite with water at a temperature below 180° F.

**445,053.**—Filter press.—R. Giebertmann.

**445,054.**—Apparatus for separating gluten from slaughter house washings. R. Giebertmann.

**445,055.**—Process of separating gluten from slaughter house washings. R. Giebertmann.

The washings are heated, treated with an aluminium compound and filtered.

**445,091.**—Process of dissolving water glass. P. Sievert.

The lump water glass is placed in a pile in a vessel and a current of steam discharged against it to soften it, while at the same time a spray of alkaline lye is applied.

W. R.

## FEBRUARY MEETING.

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The regular meeting of the society was held in the Law Lecture Room of the University Building, on Friday evening, Feb. 6th, 1891.

The meeting was called to order at 8:45, President G. F. Barker, in the chair.

The minutes of the January meeting were read, amended and accepted as amended.

The election of new members being in order the following were elected as members :

Geo. H. Clapp, 95 5th Ave, Pittsburgh, Pa.

Dr. H. Carrington Bolton, University Club, N. Y. City.

Wm. D. Crumbie, U. S. Laboratory, 402 Washington St., N. Y.

F. E. Dodge, care of N. Y. Tartar Co., 9th St. and Gowanus Canal, Brooklyn, N. Y.

J. T. Evans, 606 Montgomery St., San Francisco, Cal.

Prof. L. P. Kinnicutt, Polytechnic Institute, Worcester, Mass.

Prof. Rachel Lloyd, Univ. of Neb., Lincoln, Neb.

Prof. E. F. Ladd, North Dakota Agricult. College, N. D.

Prof. Hudson H. Nicholson, Univ. of Neb., Lincoln, Neb.

Edward Scherer, U. S. Laboratory, 402 Washington St., N. Y.

Albert H. Welles, N. Y. Tartar Co., 9th St. and Gowanus Canal, Brooklyn, N. Y.

C. H. White, Mare Island Navy Yard, Cal.

For associate membership :

Prof. P. W. Bedford, 66 Duane St., N. Y.

D. H. Burrell, Little Falls, N. Y.

Prof. Chester Huntington, Flushing, L. I.

The following proposals for membership were then read :

Francis C. Blake, Pennsylvania Lead Co., Mansfield Valley, Allegheny Co., Pa.



C. P. Gundy, Eliza Furnace, Pittsburgh, Pa.

M. De L. Haigh, care of Meyers Bros. Drug Co., St. Louis, Mo.

Henry Heim, East Saginaw, Mich.

Wm. Heim, East Saginaw, Mich.

Prof. J. L. Jarman, Emory and Henry College, Emory, Va.

G. A. Kirchmaier, City Chemist, Toledo, O.

Oliver S. Ledman, 9 N. High St., Columbus, O.

Edw. D. Pearce, care of T. P. Shepard & Co., Providence, R. I.

J. D. Pennock, care of Solway Soda Co., Syracuse, N. Y.

Prof. F. C. Robinson, Bowdoin College, Brunswick, Me.

Herbert W. Snow, care of F. Stearns & Co., Detroit, Mich.

C. W. Teeter, Peoria, Ill.

E. Fred. Wood, 85 Fifth Ave., Pittsburgh, Pa.

For associate membership :

L. D. Arnold, Rumford Chemical Works, Providence, R. I.

The reading of papers being next in order, Mr. J. F. Geisler read a paper on the "Signification of Lactometer Tests."

Dr. A. R. Leeds read the following papers: "Estimation by Titration of Dissolved Carbon Dioxide in Water." Discussion by Messrs. Barker, Breneman, Doremus, Kent, Hallock, Pellew and others.

"On the Precipitation of Suspended Clay by Aluminic or Ferric Hydroxides, or by means of Calcium Hydrate." Discussion by Messrs. Pellew, Hallock and Breneman.

"On the Proteids of Cow's Milk." Discussion by Messrs. Breneman and Pellew.

As there was no further business, the meeting was then adjourned.

DURAND WOODMAN,

Rec. Sec'y.

## OBITUARY.

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WILLIAM RUPP.

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William Rupp, Librarian of the American Chemical Society, and for many years an active and devoted member, died suddenly on the evening of February 17th, from the effects of a chronic inflammation of the throat.

Mr. Rupp was born in the city of New York, in the year 1855, and pursued his studies in chemistry and mining engineering in the School of Mines, Columbia College, New York. Subsequently he went to Germany and spent two years in the study of mining engineering at Freiberg. On his return to New York he was for some time an assistant in mineralogy in the School of Mines and afterwards opened an office in the lower part of the city as analytical and consulting chemist where he followed his profession to the day of his death.

He had taken much interest of late years in the work of the American Chemical Society, and much of the success of the Newport and Philadelphia meetings of the society was due to his individual effort. Almost the last act of his life was done as Chairman of the Committee of Arrangements for the dinner which was to have been given in honor of the fiftieth anniversary of the foundation of the English Chemical Society. The dinner was given up on account of his death.

Mr. Rupp was a member of the London and also of the Berlin Chemical Society.

# THE PROTEIDS OF COW'S MILK.

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BY ALBERT R. LEEDS.

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## I.

*Upon the three varieties of casein found in milk by E. Duclaux.\**

According to the first communication of this author, there is not simply one variety of casein in milk. Besides solid casein, which is seen to fall to the bottom of the vessel on the milk standing (in one case representing 0.4 p. c. of all the casein), there is casein in a colloidal state, passing through all paper filters, but unable to pass through a filter of baked porcelain. After filtration through porcelain, the filtrate, containing according to Duclaux, no casein, gives a precipitate upon the application of heat (Albumin). After filtering off this precipitate, subacetate of lead and Millon's reagent throws down a third albuminoid substance which is the lactoprotein of Millon and Comaille.

He states that if the material arrested by the filter be removed and suspended in water, it will nearly all dissolve ( $\frac{3}{4}$  of it in the course of three years) and that it dissolves as lactoprotein, or at least with all the characteristics of lactoprotein. Simply suspending the casein in water serves to bring about the appearance of all those materials which have been met with and sought for as affording characteristic reactions in milk. All these are presented, the casein passing from one to another by insensible transitions, but tending more and more towards those which are perfectly soluble. This is stated to be especially perceptible when the casein is suspended in water which is slightly acid or alkaline. He concludes by stating that casein seems to be a plastic substance modifying itself in an acid, alkaline or neutral medium and dissolving in variable quantities, varying with the time and also with the composition of the liquid. And hence, if the reaction of the liquid be

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\* Sur les Matieres Albuminoids du lait. E. Duclaux. Comptes Rendus de l'Academie des Sciences, 98, 373 (1884).

changed from an acid to an alkaline, or vice versa, or if any substance be added, a precipitate may occur, and thus be originated the numerous bodies which have been extracted from milk.

In a later communication (ib. 98, 438), Duclaux claims for his procedure with a porcelain filter, the merit of a new method for the analysis of milk. He regards the determination of albumin and lactoprotein as vain and illusory, believing that the important matter is to separate and determine the casein only. The casein, according to this second communication, exists in three forms :

First. Dissolved casein.

Second. Casein in suspension.

Third. Casein in a colloidal condition.

He restricts himself to the determination of the dissolved casein only, because he regards this dissolved casein as "The final form towards which the two other forms tend, and because its variations exhibit all the transformations which milk undergoes whether in industrial use or in alimentation."

By the porcelain filter he arrests the elements "in suspension, viz. : the fat, the last two varieties of casein and also a part of the phosphate of lime," whilst the elements "in true solution" pass through the filter; viz.: the milk sugar, the remainder of the phosphate of lime and the other mineral salts.

Heat, Duclaux goes on to state, influences the casein but little, giving to the suspended casein cohesiveness and changing it from a mucous state to one more condensed, which is seen from the deposit on the tube of porcelain after filtration. In boiled milk this deposit is always more resistant and less voluminous than in raw milk. Slight acidity causes a small portion to pass from the colloidal into the solid state while a slight alkalinity sends a portion of the solid into the colloidal condition, but neither of these influences sensibly change the proportions of the dissolved casein. The same may be said to be true of pressure. Hence the quantity of dissolved casein in a sample of milk is very stable, and what is more, is seemingly independent of the nature of the milk. Duclaux states that he found nearly the same proportion in cow's milk from different sources, and in goat's, ass's and human milk. Also, that there are two influences which augment the quantity of casein in solution, viz. :

First.—The addition of water which, however, is but slightly active.

Second.—Intervention of a diastase (“casease”). The latter is the more powerful influence, and this casease is prepared by introducing the microbes which produce it, and which act in a manner similar to a pancreatic ferment.

I have repeated the experiments of Duclaux, the especial interest of which lies in the character and quantities of the substances separated out by the porcelain filter, and while my experiments accord with his in respect of the great changes in the composition of the filtered milk thus obtained; yet there are important, and as it appears to me, very significant discrepancies.

Duclaux obtained :

	“In Suspension.”	“In Solution.”
Fats.....	3.32 per cent.	----
Milk sugar ....	----	4.98 per cent.
Casein.....	3.31 per cent.	0.84 “ “
Calcium phosphate	0.22 “ “	0.14 “ “
Soluble salts.....	----	0.39 “ “
	<hr/> 6.85	<hr/> 6.35

In my own experiments a new Chamberland-Pasteur filter was employed, the milk being placed in a glass tube 8 feet in height and in a funnel reservoir at its top. The funnel was plugged with cotton wool to exclude atmospheric micro-organisms. After three hours not a drop had come through and aspiration was found requisite. The reaction of the filtrate was feebly acid, but not more so than the milk before filtration. Its specific gravity was 1.021 at 15°C, while that of the original milk was 1.033.

	Raw Milk.	Filtrate.	Residue.
Fats .....	2.18	none	2.18
Milk sugar.....	4.749	4.291	0.458
Casein .....	2.96	none	2.96
Proteids other than casein (lactalbumin?)	0.69	0.085	0.605
Ash.....	0.751	0.414	0.337
Total Solids.....	<hr/> 11.33	<hr/> 4.790	<hr/> 6.540

The first important difference is that a portion of the milk sugar is arrested, ten per cent. of the total amount present remaining in the residue.

The next is in regard to the casein. The substance termed casein in my analysis is the proteid precipitable by dilute acid. In the raw milk the total proteids were determined according to Ritt-hansen, the casein by dilute acid, and the other proteids as the difference. In the filtrate the total proteids were found by determining the nitrogen and multiplying by 6.45. Dilute acid produced no precipitate and hence casein is put down as entirely absent. It is noteworthy that while the proteids as found in the filtrate by the above method were 0.119 per cent., their amount as determined by precipitation with alcohol was 0.0848 per cent. These other proteids had the department of "lactalbumin" and are so reported.

According then to my experiment 2.96 per cent., or all the casein, was taken out by the porcelain filter and also 0.571 per cent. (or 83 per cent. of its total quantity) of the lactalbumin.

It is still a matter of debate as to the form in which the casein exists in milk, many regarding it as in part suspended and in part dissolved, whilst Duclaux adds a third condition—the colloidal. Certain it is that the porcelain removed it all.

But there has never been any question as to the condition of the lactalbumin, all holding it to be in a state of solution. Nevertheless, the filter, assisted by the dense coating originated during the process of filtration, has removed 83 per cent. of this dissolved substance.

The phosphoric anhydride in the solution was 0.085, corresponding to the tribasic calcium phosphate 0.0185 if we grant that it is in this form the phosphoric acid is combined.

The preceding experiments left quite undecided some questions arising from the statements of Duclaux.

In the first place, the statement that in the course of time nearly all the casein redissolves, and that this redissolved casein is filterable through the porcelain, and that the filtrate presents all the characteristics of lactoprotein. "The mere placing of the casein in suspension in water is sufficient to provoke the appearance in

the liquid of all the series of materials which people have encountered in milk, and to which they have endeavored to ascribe distinctive characters. All the terms of this series are present in the beginning, the casein passes from one to the other by insensible transitions, but it tends more and more towards those which correspond to a state of perfect solubility."

Later on, where he speaks of casein as a plastic substance, Duclaux objects to giving different names to the various precipitates obtained from milk, regarding the determination of the percentage of dissolved casein as the only point necessary, all the other soluble proteids in milk being simply in a condition of transition towards this state of dissolved casein.

If these suppositions are correct, then on washing the residue left by filtration on the exterior of the filter by passing a sufficient volume of wash water through it, removing it from the filter, diffusing it in water, dissolving as far as possible the soluble from the fatty and other matters and again filtering, the filtrate should present the characters of casein, and not of lactalbumin or other soluble proteid.

The results of this treatment were as follows :

	Raw Milk.	First Residue.	First Filtrate.	Second Residue.	Second Filtrate.
Casein.....	2.47	3.19		3.1474	
Other Proteids	0.94		0.22		0.043
Fats.....	4.39	3.568	5.101		
Milk-sugar....	4.279				
Phosphoric An- hydride.....	0.223	0.084	0.139		
Calcium Phos- phate (calcu- lated) .....	0.487	0.183	0.303		
Ash .....	0.751	0.112	0.639		
Total Solids	12.83	6.87	5.96		1.04

It will be seen that the statements of Duclaux are not borne out by the analytical results. Nearly all the proteids were arrested

by the first filtration including all the casein and all the other proteids, except the small amount of the truly soluble proteid which carried the ferment (0.22 p.c.). And that on the second filtration, no casein was present in the filtrate, but, as in the first instance, was all arrested by the filter. The still smaller amount of the truly soluble proteid which passes through (0.043 p.c.) was in all probability the minute amount left in the first residue of total casein and lactalbumin and not removed from them by washing.

The conclusion which may fairly be drawn from these results is :

First. That whatsoever is the condition of the casein (and the reactions are most in accordance with the supposition that it is present as an alkaline caseinate), it is held in the milk in a colloidal state, and can therefore be filtered out on a porcelain filter. Furthermore, that the lactalbumin is likewise held in the milk in a colloidal state, and is filtered out along with the casein. But the starch liquefying ferment, the "galactozymase," is in a state of true solution and passes through the filter.

The milk sugar reported as being present in the residue is simply that part which is detained in the dense skin or coating of proteids and fats, and not removable by washing. A separate experiment was made with a milk sugar solution filtered through a new Pasteur filter. It was found that the filtrate contained precisely the same percentage of dissolved milk sugar as the original solution, showing that there was no stoppage of this truly dissolved substance owing to the magnitude of its molecules and the fineness of the pores of the filter.

Nearly as much of the phosphates present are retained on the filter as pass through, and they constitute nearly, if not all, the mineral residue in the former case. Indeed, if calculated as tri-basic calcium phosphate, the amount would much exceed the total ash of the residue on the filter. That they do not exist in this form is evident, but in what condition of partial saturation has not been determined. In this connection the influence of lime upon the precipitation (or coagulation?) effected by rennet is noteworthy, as is also the relation which the phosphoric acid bears to the casein molecule.



## II.

*The casein obtained by the action of rennet, and the casein obtained by the action of dilute acid.*

In a recent communication by Prof. W. D. Haliburton,\* the proteid which is present in the milk is termed caseinogen, and that which composes the curd found under the ferment action of rennet is termed casein. And still further the casein-producing substance (or caseinogen) is not only called caseinogen while it stands for the proteid as it exists in milk, but after it has been precipitated out of solution by the action of a dilute acid, like acetic acid.

The nomenclature appears to be based upon the interpretation given by Hammersten to the results which he obtained while studying the action of rennet, and from which he concluded that the rennet acting as a ferment produced two substances neither of which exist pre-formed in the milk. One of these is the insoluble part, the curd, called above casein, the other a soluble proteid, called by Haliburton whey-proteid.

In other words, caseinogen plus rennet produces casein plus whey-proteid, and caseinogen plus acetic acid produces caseinogen plus acetate of — ?

According to Hammersten the above casein (from rennet) differs from the casein (produced by acid) by its lesser solvent power upon calcium phosphate, and especially by its no longer having the property of coagulating under the influence of rennet. According to Haliburton in order to restore to casein (produced by acid, his caseinogen) the casein producing property, it must be redissolved in an alkali, preferably lime, with the addition of phosphoric acid, in order to form the necessary amount of calcium phosphate, and so finally rendered coagulable by rennet. Only after this manipulation does it give the insoluble curd and the soluble whey-proteid.

I find it very difficult to draw the inferences above stated from the observed facts. That both alkaline substances and phosphoric acid play an essential part in the phenomena is admitted. But no one, so far as I am aware of, has traced out the effect of these

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\* The Proteids of Milk, Journal of Physiology, 11, 449.

mineral salts satisfactorily, nor shown what manner of combinations they form with a proteid (probably a complex organic acid) like that we are dealing with.

The hypothesis at present most generally entertained is, that the casein exists in combination with the alkali only, and that on forming with the aid of the dilute acetic acid an alkaline acetate, the casein is set free. But this reaction and the difficulty of identifying the casein such as it exists in milk with alkali-albuminate in all respects, are both reconcilable with the possibility of the existence in milk itself of a complex compound of the casein-producing substance and the mineral substances present.

When rennet is used, the casein-producing substance is in part precipitated along with some of the phosphoric acid and mineral constituents, and another part remains in solution associated with the remainder of the phosphoric acid and mineral salts. And until these two portions, the insoluble and the soluble, are obtained free from the mineral salts accompanying them it would appear to me to be premature to state that the proteid precipitated by rennet is in itself different from the proteid precipitated by dilute acid. And furthermore, until the influence of these mineral constituents is allowed for, that it is premature to state that rennet acts as a ferment in such wise as to form two new proteids, an insoluble and a soluble, neither of which existed pre-formed in the milk.

These difficulties were not lessened by my own experimental results. On coagulating some milk with rennet, and examining both curd and whey I found :

	Raw Milk.		Curd.	Whey.
Proteids precip. by acid .....	2.47	Total Proteids	2.41	.....
Proteids non-precipitable by acid	0.94	Total Proteids	.....	1.00
Phosphoric anhydride .....	0.223		0.102	0.121
Calculated as				
Tricalcic phosphate .....	0.486		0.222	0.264
Ash .....	0.751		0.247	0.504

From which result it would appear that the proteid precipitable by acid (casein), and that non-precipitated (lactalbumin) in the raw

milk are respectively the same as the total proteids in the curd or casein produced by rennet and in the whey. If a new soluble proteid (the whey proteid) is produced by the action of rennet, then I should have anticipated that the total soluble proteids in the whey would have been materially increased. But this is not the case,

Furthermore, both the curd and the whey contain about the same amount of phosphoric acid, and this and the other mineral bodies remain in each to modify profoundly their deportment with the reagents used as tests.

### III.

*Upon the Three Varieties of Proteids Present in Cow's Milk according to A. Bechamp, and upon the Phenomena of Coagulation\*.*

This author discusses and objects to the many distinct phenomena which chemists describe under the one term coagulation. In this article he applies the term to the production of proteid precipitates insoluble in water, by means of alcohol and by heat. And on the supposition that the casein in cow's milk exists as an alkali-albuminate from which the coagulum is thrown down simply by displacing the alkali with the aid of an acid, he speaks of precipitating the casein, not of coagulating it. His experiments are directed to showing, moreover, that casein is a soluble substance and that it is not coagulable.

He finds that besides casein there are two other proteids present in milk, one of which is coagulable by alcohol (lactalbumin) while the other is not (galactozymase). Both are coagulable by heat, and are rendered by it insoluble in their natural solvents (by which he refers more especially to water).

The procedure followed by Bechamp is as follows: To prepare pure casein he adds to the fresh milk, in the cold, acetic acid, drop by drop, until the liquid plainly turns litmus paper the color of onion skin, at which point the dicaseinate first formed is completely decomposed. Soon after the milk is curdled. The whey filters clears whilst the casein is precipitating, brings down the

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\*Bull. Soc. Chim. (3), 4, 181-186.

“milk globules” and “microzymes.” The precipitate is then washed to free it from all the soluble matters, and after draining its fat is extracted with ether. Then, after being again washed with water, it is diffused through a volume of water equal to that of the milk originally taken, and which has been rendered distinctly alkaline with ammonium sesquicarbonate. The precipitate dissolves, but the solution becomes turbid from the debris of the globule envelopes and from the microzymes. The casein is then precipitated by adding just sufficient acetic acid, and washed with water. If it is pure, the wash waters are not rendered turbid either by ebullition, or by the addition of alcohol. If they are, it is necessary to redissolve and reprecipitate, etc. By prolonged washing the casein is obtained in a pure condition always presenting the same characters.

It dissolves slowly and in small amount at common temperatures, a litre of water dissolving during 52 hours 1.005 grm. It melts at higher temperatures and its solubility increases; 2.37 grms. going into solution in a litre of water raised to ebullition.

It deports itself as a feeble acid which acetic acid precipitates from its solutions, as in milk (so Bechamp states, although it would appear from his earlier statements in this article, that it is with alkali caseinate we have to do in milk and not pure casein), on account of its relative insolubility. It is not coagulated by acid or heat. Its solutions redden litmus paper in the same manner as carbonic acid; but it can form with potassa, soda, ammonia and lime, soluble acid caseinates which redden litmus and which carbonic acid does not precipitate. The caseinates of these bases form solutions which are not precipitated by alcohol and which are not coagulable by heat. At the boiling point, however, a solution of calcium caseinate appears to coagulate, but on cooling the apparent coagulum dissolves. All these reactions distinguish casein from albumen.

The whey from the casein is coagulable by heat and the coagulum is at the same time insoluble in water and in ammonium sesquicarbonate. To the clear whey alcohol of 95% is added as long as a precipitate forms, two volumes at least being required. The voluminous precipitate is freed from milk sugar by means of alco-

hol of 80%, then drained and before drying it is stirred into water and after an interval thrown upon a filter. Something dissolves which is precipitable by alcohol, and the washing is therefore continued until the wash water gives no precipitate with alcohol.

The undissolved portion is dissolved by dilute solution of ammonium sesquicarbonate, leaving an insoluble residue of mineral matters. The ammoniacal solution, treated by acetic acid, forms a precipitate which when collected and washed with water represents *lactalbumin*.

The part precipitated by alcohol but soluble in water is *galactozymase*. When it has been freed from lactalbumin by repeated solutions and reprecipitations, it is completely soluble in water, and it can come to pass that alcohol will no longer precipitate it except on the addition of a trace of sodium or ammonium acetate. The galactozymase of cow's milk liquefies starch paste but without saccharification.

It is evident that lactalbumin exists in the whey in a soluble form. But on precipitation with alcohol it loses its solubility in water, while remaining soluble in ammonium sesquicarbonate. If, however, it is diffused through water and heated to 100 degrees, it contracts without softening and becomes insoluble not only in ammonium sesquicarbonate but also in dilute ammonia.

Galactozymase is in no wise coagulable by alcohol, but yields solutions which heat coagulates whilst depriving them at the same time of their zymasic function.

The specific rotatory power of the aqueous solution of casein for sodium light is  $(\alpha)_D^{20} = -117^\circ$ ; the rotatory and other definite properties of lactalbumin and galactozymase distinguish them absolutely from casein and from albumin, and prove them to be sharply defined, distinct chemical species.

Inasmuch as I have been attempting to discriminate between raw and heated milk by whatever processes appeared available, I have repeated the valuable work of Bechamp in this connection, and have obtained certain interesting results. The method was employed as a basis for analysis, the milk analyzed (A) being in part raised to boiling (B) and in part heated in a sterilizer for one hour at 100° (C).

	A	B	C
Casein,	3.370	3.559	3.653
Lactalbumin,	0.428	0.534	0.366
Galactozymase,	0.314	0.055	0.056
	<hr/> 4.112	<hr/> 4.148	<hr/> 4.075

The conclusions arrived at from these analyses are :

1st. Raising the temperature of milk to the boiling point, and still more the retaining of it in that condition for a lengthened period, as in sterilization, converts a considerable portion of the soluble into insoluble proteids.

2d. The effect of heat is greatest upon the galactozymase, which is as much thrown out of solution by raising the milk to boiling, as it is by keeping it at 100° for an hour.

3d. By prolonged heat the lactalbumin is also partly thrown out of solution in the milk. I say milk, because I am speaking of what takes place in presence of the saline and other constituents of milk, and not what may be true of the coagulability and insolubility of these proteids under other conditions.

4th. If these analyses are correct, raw milk should possess the power of liquefying starch. Milk from which the casein is removed should have that power. Both whole milk and milk deprived of casein should lose the power of liquefying starch merely on its temperature being raised to the boiling point. These suppositions were confirmed by experiments narrated under a separate head.

5th. By heating, the percentage of what is put down in analyses as casein is increased, the increase and the error being greater as the boiling is continued.

6th. I have been unable to satisfy myself that the portion of the casein insoluble in ammonium carbonate represents the debris of the envelopes of the fat globules and the "microzymes." If so, and these envelopes exist, they must be of marvelous tenuity, since the weight of this portion amounted to only 0.0256°.\*

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\* On repeatedly shaking milk with bisulphide of carbon, the latter separates out, carrying with it a white substance which imparts to the

“The theory of an envelope to the fat globules in milk is persistent, but difficult to maintain. Babcock's experiments on butter making showed that churning cream above 85° F. merely reduced the size of the globules. The globules cannot renew their envelopes in proportion to their size as they break up; yet they are not changed in properties, as they would be if the envelope had been destroyed by rupture.

“Apart from the action of fat solvents on milk fat when in its normal condition, there is little to suggest the existence of an envelope. May not the apparent properties of an enveloped globule be equally well explained by the theory of a globule of fat suspended in a liquid of different constitution from pure water, somewhat ropy or mucilaginous, as milk apparently is, and therefore exhibiting different relations of surface tension with reference to the fat globule, as compared with the relations held to the latter by pure water?”

#### IV.

##### *Upon the Starch Liquefying Ferment in Cow's Milk and Human Milk.*

If it be true, as the conclusion set forth under the fourth head in the preceding article would intimate, that there is naturally present in untreated milk a starch-liquefying ferment, the result would be of much interest from its bearing upon infant nutrition.

Inasmuch as changes might be produced in the milk by the processes and reagents employed, I experimented in the first place upon the limpid sterilized liquid obtained with the Pasteur filter,

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bisulphide layer at the bottom almost the appearance of barium sulphate precipitate. After many washings with water, this yielded after evaporation a percentage of nitrogen corresponding to 0.51 p. c. of the milk treated. It was thought that by osmose the bisulphide might extract the fat, leaving the envelopes of the fat globules intact. I do not consider the above as adding anything additional to the inadequate experimental evidence on which the existence of these hypothetical envelopes rests, and quote the following comments by Prof. Breneman upon this point. His description of the character of the fluid part of the milk, as “somewhat ropy or mucilaginous,” I have quoted as aptly expressing a similar conception on my own part.

and which contained in all but 0.119 per cent of proteid matter. The amount and energy of the ferment cannot be otherwise but small, for on treating a paste of one grm. of starch in 200 c. c. water with 5 c. c. of this liquid, it required from 3 to 6 hrs. digestion at 34.5° C. to render the starch entirely fluid. As such it ran readily through a filter, whereas before digestion with ferment it was unfilterable.

On heating to 75° C. the ferment was destroyed, a white coagulum being formed, and the filtrate from the Pasteur filter being entirely without action on starch.

The same results were obtained with 5 c. c. of the original cow's milk. It liquefied the starch paste, but after heating to 75°, or still more readily on boiling, entirely lost this property.

The whey obtained from the milk by the action of rennet was also destitute of a ferment capable of liquefying starch. As a control experiment, the rennet itself was tested and likewise found to be without such action.

On throwing down the casein with dilute hydrochloric acid, the filtrate appeared to have a slight action on the starch.

Human milk behaved in the same manner as cow's milk, but appeared to act with somewhat greater energy. On heating to 75° C., it entirely lost its power of liquefying the starch.

The percentage of galactozymase it will be noted is quite comparable to that of the lactalbumin in the analysis previously given, being as 0.314 to 0.428 per cent. But the result of the repeated washings and the solution would all tend in this direction: that is, to raise the percentage of what is put down as galactozymase. In the same milk, after heating to boiling, and at 100° C. for an hour, the same body is obtained by analysis though in much smaller amount, being only 0.055 per cent. It is doubtful if it is present at all since these heated specimens had entirely lost the starch liquefying property.

It is more probable that the correct amount of the galactozymase is more nearly represented by the small percentage of coagulable proteid obtained in the filtrate from the Pasteur filter 0.119, and which possessed more strikingly the property of starch liquefaction than any other condition or derivative of the cow's milk experimented upon.



It is, therefore, to be inferred that there is in cow's milk, besides the casein and albumin existing in a colloidal condition, and which are removed by filtration through a porcelain filter, a third proteid which is soluble and dissolved in such a condition that it passes through the filter. This proteid appears to be the galactozymase, which already has been differentiated from lactalbumin on the ground of greater solubility and other properties.

## V.

*The Behavior of Raw and Sterilized Cow's Milk with Acid and Rennet at 34.5° C.*

In the preceding comparisons of raw and heated cow's milk, the tests and analyses were made upon the samples when cold. But it is evident that the natural physiological processes of digestion take place at a higher temperature, and that deductions based upon tests made in the cold might lead one quite astray in relation to the phenomena of nutrition. The milk was diluted with eight times its volume of water.

	Raw.	Sterilized one hour at 100° C.
0.2 p. c. hydrochloric acid.	No precipitation. Merely a turbidity like dilute milk.	Similar to the raw. But more opaque (clots of albumen).
Rennet.	Imperfect coagulation. Opaque liquid and filtrate.	Similar to raw. No curd separating, but slimy clots.

The experiments were then repeated on the raw and sterilized milk without dilution. After digestion with dilute acid and rennet for fifteen minutes they were cooled to 15° C., then diluted with eight times their volume of water and the precipitate, if possible, separated from the filtrate.

	Raw.	Sterilized one hour.
0.2 p. c. hydrochloric acid.	Imperfect precipitation. Turbid liquid and filtrate.	Similar to raw, but non-filterable. Clots.

		Curdled at once.	No curd separating.
Rennet.		Curd } Whey } See Analyses.	Clots (separated albumen) as found in milk long heated to 100° C.
Rennet + 0.3 p. c. hydrochloric acid.	15 mins.	Same appearance as with HCl alone.	Same as raw.
	1 hr.	As above.	" "
	30 hrs.	Some clots in clearing liquid.	Some clots. Liquid opaque.

Preceding experiments repeated, but with 0.3 p. c. pepsin added. The curdling with rennet was done before dilution, the raw milk setting at once to a stiff jelly, the sterilized forming no jelly.

		Raw.	Sterilized.
0.3 p. c. HCl + 0.3 p. c. pepsin.	15 mins.	Very similar to expt. with HCl alone.	Same as raw.
	30 mins.	Granular, from an incipient separation.	No change.
	1 hr.	Large flocks in turbid menstruum.	Beginning to granulate.
	1½ hrs.	As preceding, but menstruum clearing.	Some separation, flocks beginning to form.
	30 hrs.	Fine coagula at surface, liquid perfectly clear.	Similar to raw, but liquid not perfectly clear.
Rennet + 0.3 p. c. HCl + 0.3 p. c. pepsin.	15 mins.	Curd rapidly dissolved. Same as with gastric juice alone.	Coagula attacked and finally like raw.

30 mins.	Granular.	Unchanged.
1 hr.	Flocks in turbid menstruum.	Unchanged, no flocks.
1½ hrs.	Menstruum clearing.	Unchanged.
30 hrs.	Fine coagula on surface. Liquid clear.	Coarse coagula on top. Liquid turbid.

## VI.

*Behavior of Raw and Sterilized Milk with Acid, Rennet and Artificial Gastric Juice at 43° C.*

Having noted the results obtained with acid alone and rennet alone, it was desirable to repeat them in connection with the peptic ferment, to determine the relative action of the reagents employed, and the relative digestibility in these media of the milk before and after sterilization. 25 c.c. of the milk was used and made up to 200 c.c., the solution containing 0.3 p.c. real hydrochloric acid. The experiments were first repeated with these materials alone and then afterwards with rennet, no pepsin being employed.

	Time.	Raw.	Sterilized.
	15 mins.	Translucent, the solids somewhat dissolving.	Same as raw.
0.3 p. c. Hydrochloric Acid.	1 hour.	Same as above. No Precipitation.	“ “ “
	30 hours.	No further change.	“ “ “
	15 mins.	Imperfect coagulation. Opaque and like the mixture of milk and water alone.	Similar to raw.
Rennet alone.	1 hour.	Similar to above.	“ “ “
	30 hours.	Coagulated.	Slimy clots, not curd.

The milk employed in these experiments was carefully analyzed with the hope of determining the amount and nature of the changes. But inasmuch as the hydrochloric acid appeared not only to combine with and carry some of the casein into solution, but also to form with the casein imperfectly or not at all precipitated, a turbid non-filterable liquid, the analyses could not be proceeded with. The only quantitative result was that yielded by rennet. But even the curd formed by it could not be filtered from the dilute and turbid whey, by means of ordinary filters. It was necessary to use a Pasteur filter. This separated all the proteids except that minute amount which appears to be persistently soluble, and did not give a true result as to those which were present in the curd and those which remained behind in the whey.

	Original Milk.	Filter Residue.	Filtrate.
Casein.....	2.317	3.01	0.123
Other proteids .....	0.813		
Fats .....	4.12	4.65	3.07
Milk-sugar .....	3.578		
Ash .....	0.772	0.254	0.518

## VII.

*Artificial Digestion of Raw and Sterilized Cow's Milk.*

An attempt was then made to determine quantitatively the amount of change effected in raw and sterilized milk, by operating upon portions of the same sample of milk before and after heating, with artificial gastric juice and with pancreatic extract.

25 c.c. of milk was used in each experiment, the peptic digestion being as previously stated. In the pancreatic the 25 c.c. was made up to 200 c.c. with water containing in solution 195 mgms. (3 grains) sodium bicarbonate and 65 mgms. (1 grain) pancreatin. After digestion for six hours at 43°, the liquids were allowed to stand over night and then filtered. The peptic products could be filtered in the ordinary manner, since the liquid portions were clear and limpid. But those from the pancreatic digestion were not clear and were only filterable through porcelain.

The raw milk which was employed in the experiments was completely analyzed with a view of determining the condition of all the constituents in the product of digestion, but the research was beset with so many difficulties, that at present the only figures reported are those for the residues :

	Original Milk.	Peptic Digestion.		Pancreatic Digestion.	
		Residue from Raw	Sterilized.	Residue from Raw	Sterilized.
Casein .....	2.58				
Other proteids..	0.84				
Total proteids..	3.42	0.153	0.449	1.26	2.596
Fats .....	2.26				
Milk-sugar .....	4.69				
Ash.....	0.71				

The fat globules appeared to remain quite unaltered during the process of digestion, and this was true not only of the peptic, but of the pancreatic action, although in the latter the reaction of the menstruum was alkaline. Under the microscope in the latter case, no change could be discovered in the appearance of the fat globules, either as to size, form or probable number. This remark is more especially true of the products from the raw milk which exhibited but little else than the fat globules, the shreds of residual nitrogenous matter, being relatively inconspicuous. The residue from the sterilized milk exhibited more undigested nitrogenous matter, and this adhered in many places to the fat globules, somewhat distorting their outlines with sharp angular indentations. But the phenomena were not in accordance with the supposition that the fat globules were originally encased in a membranous envelope. In one instance at least, the nitrogenous residue was submitted for many hours to further digestion (the residue from the peptic action on raw milk) and no further solution occurred. Furthermore, this particular residue, amounting to only 0.153 p.c., in all probability was suspended as insoluble matter in the original raw milk. It gave the reactions of Nuclein. In the ordinary course of analysis it would be thrown down along with the precipitate produced by dilute acid, and would be included in the casein.

The residue from the sterilized milk was much greater in both the peptic and pancreatic digestion than that from the raw. With both varieties of milk the latter digestion gave greater residues than the peptic, but the amount of pancreatin employed was relatively less also. That the effect of sterilizing was greatly to retard the rate, and diminish the amount of digestion was evident. The clinging of the undigested residues to the fat globules of the sterilized milk was also a prominent adverse factor.

#### CONCLUSIONS.

From the preceding discussion it would appear that there are three classes of substances which are present in normal cow's milk.

1st. Substances in suspension, including :

Nuclein, an organic compound containing phosphorus, the composition of which has not as yet been satisfactorily determined.

Fat globules, destitute of envelopes, and swimming in a colloidal ("somewhat ropy or mucilaginous") fluid, the physical characters of which are favorable to their persistence as separate globules under ordinary conditions of temperature and reaction.

2d. Substances present in a colloidal condition, including :

Casein and lactalbumin, the former of which appears to be in combination with alkali, and probably also with lime and phosphoric acid, and is precipitable by dilute acid.

3d. Substances present in solution, including :

A nitrogenous starch liquefying ferment "galactozymase" milk-sugar.

Common salt and certain soluble compounds of phosphoric acid.

The noted effects of sterilization are :

The starch liquefying ferment is destroyed and coagulated. After coagulation the "galactozymase" is insoluble and is carried down with and included in the precipitate obtained on addition of dilute acid.

A portion of the lactalbumin as it exists along with the other substances present in milk, is coagulated. But this coagulation is

only partial, even after long continued heating. Its effect, however, is to thicken the milk and intensify its colloidal (ropy or mucilaginous) character.

The casein is not coagulated by the heat, but is less readily coagulated by rennet, and yields slowly and imperfectly to the action of pepsin and pancreatin.

The fat globules themselves are somewhat affected by the heat, and after standing for some time lumps of butter-fat have sometimes been observed on the surface of the milk. But the coagulated proteid matters attach themselves to the fat globules and probably have an influence in bringing about the less perfect assimilation of fat, which has been noted by various observers as true of infants nourished upon sterilized milk.

The milk-sugar by long continued heating is completely destroyed, and is probably affected to a certain extent during the interval ordinarily allowed for sterilization.

Sterilized milk is less readily and less perfectly digestible than raw milk, and if sterile milk is sought for, the present desideratum is to obtain it either directly from the animal, or by a process not accompanied by such serious drawbacks. In the performance of the many analyses required in the course of this investigation, I desire to acknowledge the aid of my assistant, Mr. William G. Johnston.

## SIGNIFICATION OF LACTOMETER TESTS.

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BY JOSEPH F. GEISLER.

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The lactometer plays such an important part in the sanitary inspection of milk, that it may not be amiss to inquire into the signification of the lactometer tests, inasmuch as the indications of the same are frequently misinterpreted. The lactometer is familiarly known as a special form of delicate hydrometer or specific gravity instrument adapted to the requirements of milk testing.

The lactometer adopted by the N. Y. City Board of Health some years ago is a glass hydrometer about twelve inches long, the stem containing the scale being about  $5\frac{1}{2}$  inches in length, and the bulb and weighted section making up the rest of the instrument.

There are also lactometers in use containing a delicate thermometer so that the temperature and specific gravity can be read off at once.

The instrument is so standardized that at  $60^{\circ}$  F. its 0 mark will indicate the specific gravity of water, its  $100^{\circ}$  and  $120^{\circ}$  marks a specific of 1.029 and 1.0348 which have been adopted respectively as the lowest and highest specific gravities of pure milk. The greater the space between the 0 and  $120^{\circ}$  mark on the scale the more delicate is the specific gravity indication.

The general directions for using the lactometer are as follows : "The milk to be tested should be warmed or cooled, as the case may be, to a temperature of  $60^{\circ}$  Fahr. The lactometer is placed in it, care being taken not to wet that part of the stem above the milk. The mark at which it floats is now noted. Now take the lactometer out of the milk, and observe whether the thin film adhering to it runs rapidly off, and whether the milk appears thin and bluish, and the taste of the milk is flat and watery : if such is the case, and the lactometer floats at some point less than 100—as, for instance, 90—we are reasonably certain that water has been added. If the appearance and taste are as before stated, and it



floats at some points greater than 100, it may be skimmed, or skimmed and watered.”\*

Much depends upon the care and judgment of the operator in the use of the instrument, and it is apparent that considerable latitude is left for the exercise of personal opinion in drawing conclusions as to the indication of the test.

Inasmuch as the lactometer indicates the *specific gravity* it is pertinent to ask—To what extent is the specific gravity an indication of the purity of the milk? Does the sp. gr. indicate the composition of the milk? To those who are conversant with the facts, the questions may seem ridiculous, but those who by their blind faith in the indications of the specific gravity have come to grief will consider the question all important.

It is a well known fact that milk contains varying percentages of fat, casein, albumen, sugar, and saline matter, suspended or dissolved in a varying percentage of water. The different constituents affect the specific gravity in different degrees and their sum total determines the specific gravity of the milk at a given temperature.

It is argued that in *pure milk* the specific gravity does not exceed certain fixed limits, so that anything beyond these extremes is *prima facie* evidence that the milk is adulterated.

Let us first give our attention to milk the specific gravity of which is within the adopted limits of 1.029 (100° Lact.) and 1.0348 (120° Lact.).

The most common form of adulteration of milk consists in the addition of water or the removal of cream, while not unfrequently both practices are resorted to simultaneously. Since fat is lighter than water the removal of cream (cream usually contains 35 to 50% of fat) raises the specific gravity, while by a careful addition of water the sp. gr. can be again lowered to its former standing.

Hence the mere indication of the sp. gr. would not reveal the adulteration. Again a milk unusually rich in fat could have some of the fat removed without increasing the specific gravity sufficiently to even raise a suspicion.

Thus taking for illustration 10 gallons of milk having a specific gravity of 1.030 and containing 4.5% of fat, we should have 1318.4

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\* First Annual Rep. of the New York State Dairy Commissioner, p. 96.

ozs. of milk containing 59.32 ozs. of fat. If from such a milk .9% of fat (or 11.86 ozs.), which is just 20% of the total amount of fat, were removed, it would still leave 3.6% of fat in the milk, while the sp. gr. would be raised to only 1.0306 to 1.0307, or 106° lact. Such a milk would not reveal anything definite by the lact. test, or in its physical appearance and would pass the usual routine of inspection.

There can be no question but that considerable adulterated milk passes the lactometer inspection which, even upon the adopted standards, would not be detected by the ordinary routine of chemical analysis. It is reported upon good evidence that such practices are frequently made use of in some creameries, and it is only through circumstantial evidence that such fraudulent practices can be proven sufficiently to have the perpetrators prosecuted. It is evident that such errors are all in favor of the milkman. There is a pathetic side to the question. How about the middleman? It is not an unfrequent occurrence to find milk at 102° to 106° lactometer, which upon chemical analysis is shown to be adulterated. The physical appearance of the milk and the manner in which it runs off the lactometer is very much affected by the reaction (degree of alkalinity or acidity), age, viscosity, the size of the fat globules and the degree of color of the fat. Milk with very small fat globules of high color, will have a better appearance than a milk with larger fat globules of lighter color, other things being equal. It is for this reason, probably, that the *lactoscope* at times gives such very erroneous results, even in the hands of skilled operators.

Proportionally there is very little *pure* milk sold in bulk which will not stand the lactometer limits of 100° to 120° at 60° F. Occasionally, however, *pure* milks are found which stand only 95° to 98° on the lactometer. Their low specific gravity is due to richness in fat, and if this is of light color the appearances easily give rise to suspicion of adulteration, while the milk may be of exceptionally rich quality. It is not a very unusual thing for pure milk, which under ordinary conditions would satisfactorily

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\* It is evident that the middleman relying upon the lactometer tests must suffer the consequences of any erroneous indication of that instrument.

stand the lactometer test, to give readings considerably too low when such milk has been drawn for long distances over rough roads. It is probable that under some conditions the milk becomes aerated through the constant agitation in the cans. At least this seems the most plausible explanation to account for differences found between the inspection tests and those made later at the laboratory and verified by the picnometer. It is possible, too, that the stem of the lactometer used by the inspector had become soiled so as to depress the instrument lower than would otherwise have been the case. In several cases the inspection tests were as much as ten degrees too low. It must be evident that the lactometer tests are not so reliable as some believe them to be, and it is essential that duplicate samples be taken for analysis to verify the lactometer. Fortunately milk vendors are no longer subject to the barbarous practice of condemning milk by the lactometer alone, without giving or retaining a sample for further examination. There is little doubt that the lactometer has brought innocent persons to grief, and it must also be acknowledged that it has passed many an habitual adulterator. *In experienced hands* it is a *useful instrument*, but is not infallible in its indications.

It may appear that the instrument is indirectly an inducement for milk vendors to adulterate their milk, for they can water and skim the milk, and by means of the lactometer adjust it to pass the inspection tests by this instrument. This is not fancy but is based upon fact, for there are persons who have been cunning enough to resort to the practice. To cite a case: Milk No. 20 in the table represents the analysis of a sample taken from a can of milk which had been subjected to skillful manipulation by one who was also caught in the act. *Unless the source of the milk and the quality of the milk yielded by that particular dairy* were known, it would be impossible for the analyst to certify, from the mere data of the analysis of the sample, that such a milk was adulterated. To show that the lactometer does not indicate the composition of the milk, reference to the following table will suffice.

## TABLE OF ANALYSES,

Illustrating differences in lactometer degrees and composition of the milk :

Deg. Lact. at 60° F.	Sp. Gr.	% H <sub>2</sub> O.	Solids.	% Fat.	Cas. & Sugar.	Ash.	
1. 98°	1.0284	87.661	12.339	4.409	7.212	.718	} Pure Milk
2. 97.2°	1.0282	86.993	13.007	4.782	7.527	.698	
3. 97°	1.0281	87.094	12.906	4.860	7.346	.700	} " "
4. 98°	1.0284	88.436	11.564	3.759	7.123	.682	
5. 98°	1.0284	89.463	10.537	3.013	6.809	.715	
6. 98.2°	1.0285	88.333	11.667	3.812	7.192	.663	
7. 101°	1.0293	88.382	11.618	3.533	7.427	.658	
8. 100°	1.0290	86.620	13.380	5.239	7.521	.620	
9. 101°	1.0293	87.145	12.855	4.709	7.477	.669	
10. 100°	1.0290	89.055	10.945	3.107	7.040	.798	
11. 96°	1.0278	88.899	11.101	3.439	7.010	.652	
12. 86°	1.0250	88.874	11.123	3.857	6.613	.646	
13. 110°	1.0320	88.927	11.073	2.767	7.581	.725	
14. 82°	1.0237	89.207	10.793	4.030	6.192	.571	
15. 106°	1.0306	88.678	11.322	3.047	7.572	.703	
16. 104°	1.0300	85.962	14.038	5.624	7.701	.713	
17. 110°	1.0320	88.927	11.073	2.767	7.581	.725	
18. 113°	1.0327	88.124	11.876	3.106	8.039	.731	
19. 89.5°	1.0260	85.779	14.221	6.370	7.188	.663	
20. 112.5°	1.0326	87.106	12.894	3.692	8.423	.779	

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In the table a comparison of Nos. 7, 8, 9 and 10, which contain nearly the same percentage of solids, will show how a slight difference in the percentage of fat affects the specific

gravity. Thus between 7 and 8 the difference in fat is but .42%, and that of the lactometer degrees 10, while between 9 and 10 the difference in solids is but .32%, but the lactometer degrees 28 and the percentage of fat 1.26. Of course such differences are also attended by changes in the physical properties of the milk and can in most cases be recognized by experts.

A careful comparison of the data in the table presented will illustrate that the specific gravity alone is not an indication of the purity or composition of the milk. Lactometers ought to be restricted in their use. They are certainly useful in sorting milk, and under certain conditions sufficient to at once condemn milk absolutely. For a correct interpretation of the lactometer degrees in the examination of milk some other factors such as the percentage of total solid or fat are essential. A careful and proper use of the lactometer shows the *specific gravity* of the milk, but any inference beyond that depends largely upon the ability and experience of the operator.

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## ESTIMATION, BY TITRATION, OF DISSOLVED CARBON DIOXIDE IN WATER.

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BY ALBERT R. LEEDS.

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In the determination of the amount of lime requisite to precipitate the dissolved carbonates of lime and magnesia in natural waters, the discrepancy between the amount of carbonate remaining in solution after precipitation, and the calculated amount, is increased by failure to estimate and allow for the dissolved carbon dioxide present. This dissolved carbon dioxide interferes with the results obtained by the use of soap in the estimation of dissolved calcium carbonate. For this and many other reasons I

have laid aside the use of the soap test in the examination of waters intended for use in boilers.

The estimation of the dissolved carbonates by means of decinormal acid with methyl orange as an indicator, affords a closer approximation, and in many cases the results thus obtained agree closely with those found by gravimetric analysis. But on using the amount of lime which is required to form a neutral carbonate, the further addition of lime to saturate the free carbonic acid is the more necessary, as the waters are richer in this constituent. For the past two years I have been using the following simple method. In the case of soft waters 500 c. c. are taken, a few drops of phenolphthalein solution is added and a decinormal solution of sodium carbonate is run in until a pink tinge is obtained. This occurs when the sodium salt is changed to the bicarbonate. With hard waters 100 c. c. are sufficient. The results agree very closely with those obtained by eudiometric analysis. Thus in the case of the Hoboken water, I obtained Dec. 1st, 1890, carbon dioxide 1.03 parts; oxygen, 8.55 parts; nitrogen, 18.07 parts per 100000. This determination required, of course, the additional expenditure of time to reduce the observed results to standard pressure and temperature. By the method above given, using  $\frac{1}{2}$  litre of water, the figure directly determined for carbon dioxide was 1.01 parts.

When 500 c. c. of the water are taken, the number of c. c. of the decinormal solution used, multiplied by 2.2, gives very approximately the number of c. c. of carbon dioxide dissolved in a litre of water. If 100 c. c. of water are employed, the same result is arrived at by multiplying by eleven. Too small an amount of the indicator should not be employed, but 10 drops of a strong solution added to 100 c. c. of the water will be found sufficient.

only partial, even after long continued heating. Its effect, however, is to thicken the milk and intensify its colloidal (ropy or mucilaginous) character.

The casein is not coagulated by the heat, but is less readily coagulated by rennet, and yields slowly and imperfectly to the action of pepsin and pancreatin.

The fat globules themselves are somewhat affected by the heat, and after standing for some time lumps of butter-fat have sometimes been observed on the surface of the milk. But the coagulated proteid matters attach themselves to the fat globules and probably have an influence in bringing about the less perfect assimilation of fat, which has been noted by various observers as true of infants nourished upon sterilized milk.

The milk-sugar by long continued heating is completely destroyed, and is probably affected to a certain extent during the interval ordinarily allowed for sterilization.

Sterilized milk is less readily and less perfectly digestible than raw milk, and if sterile milk is sought for, the present desideratum is to obtain it either directly from the animal, or by a process not accompanied by such serious drawbacks. In the performance of the many analyses required in the course of this investigation, I desire to acknowledge the aid of my assistant, Mr. William G. Johnston.

## SIGNIFICATION OF LACTOMETER TESTS.

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BY JOSEPH F. GEISLER.

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The lactometer plays such an important part in the sanitary inspection of milk, that it may not be amiss to inquire into the signification of the lactometer tests, inasmuch as the indications of the same are frequently misinterpreted. The lactometer is familiarly known as a special form of delicate hydrometer or specific gravity instrument adapted to the requirements of milk testing.

The lactometer adopted by the N. Y. City Board of Health some years ago is a glass hydrometer about twelve inches long, the stem containing the scale being about  $5\frac{1}{2}$  inches in length, and the bulb and weighted section making up the rest of the instrument.

There are also lactometers in use containing a delicate thermometer so that the temperature and specific gravity can be read off at once.

The instrument is so standardized that at  $60^{\circ}$  F. its 0 mark will indicate the specific gravity of water, its  $100^{\circ}$  and  $120^{\circ}$  marks a specific of 1.029 and 1.0348 which have been adopted respectively as the lowest and highest specific gravities of pure milk. The greater the space between the 0 and  $120^{\circ}$  mark on the scale the more delicate is the specific gravity indication.

The general directions for using the lactometer are as follows: "The milk to be tested should be warmed or cooled, as the case may be, to a temperature of  $60^{\circ}$  Fahr. The lactometer is placed in it, care being taken not to wet that part of the stem above the milk. The mark at which it floats is now noted. Now take the lactometer out of the milk, and observe whether the thin film adhering to it runs rapidly off, and whether the milk appears thin and bluish, and the taste of the milk is flat and watery: if such is the case, and the lactometer floats at some point less than 100—as, for instance, 90—we are reasonably certain that water has been added. If the appearance and taste are as before stated, and it



floats at some points greater than 100, it may be skimmed, or skimmed and watered.”\*

Much depends upon the care and judgment of the operator in the use of the instrument, and it is apparent that considerable latitude is left for the exercise of personal opinion in drawing conclusions as to the indication of the test.

Inasmuch as the lactometer indicates the *specific gravity* it is pertinent to ask—To what extent is the specific gravity an indication of the purity of the milk? Does the sp. gr. indicate the composition of the milk? To those who are conversant with the facts, the questions may seem ridiculous, but those who by their blind faith in the indications of the specific gravity have come to grief will consider the question all important.

It is a well known fact that milk contains varying percentages of fat, casein, albumen, sugar, and saline matter, suspended or dissolved in a varying percentage of water. The different constituents affect the specific gravity in different degrees and their sum total determines the specific gravity of the milk at a given temperature.

It is argued that in *pure milk* the specific gravity does not exceed certain fixed limits, so that anything beyond these extremes is *prima facie* evidence that the milk is adulterated.

Let us first give our attention to milk the specific gravity of which is within the adopted limits of 1.029 (100° Lact.) and 1.0348 (120° Lact.).

The most common form of adulteration of milk consists in the addition of water or the removal of cream, while not unfrequently both practices are resorted to simultaneously. Since fat is lighter than water the removal of cream (cream usually contains 35 to 50% of fat) raises the specific gravity, while by a careful addition of water the sp. gr. can be again lowered to its former standing.

Hence the mere indication of the sp. gr. would not reveal the adulteration. Again a milk unusually rich in fat could have some of the fat removed without increasing the specific gravity sufficiently to even raise a suspicion.

Thus taking for illustration 10 gallons of milk having a specific gravity of 1.030 and containing 4.5% of fat, we should have 1318.4

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\* First Annual Rep. of the New York State Dairy Commissioner, p. 96.

ozs. of milk containing 59.32 ozs. of fat. If from such a milk .9% of fat (or 11.86 ozs.), which is just 20% of the total amount of fat, were removed, it would still leave 3.6% of fat in the milk, while the sp. gr. would be raised to only 1.0306 to 1.0307, or 106° lact. Such a milk would not reveal anything definite by the lact. test, or in its physical appearance and would pass the usual routine of inspection.

There can be no question but that considerable adulterated milk passes the lactometer inspection which, even upon the adopted standards, would not be detected by the ordinary routine of chemical analysis. It is reported upon good evidence that such practices are frequently made use of in some creameries, and it is only through circumstantial evidence that such fraudulent practices can be proven sufficiently to have the perpetrators prosecuted. It is evident that such errors are all in favor of the milkman. There is a pathetic side to the question. How about the middleman? \* It is not an unfrequent occurrence to find milk at 102° to 106° lactometer, which upon chemical analysis is shown to be adulterated. The physical appearance of the milk and the manner in which it runs off the lactometer is very much affected by the reaction (degree of alkalinity or acidity), age, viscosity, the size of the fat globules and the degree of color of the fat. Milk with very small fat globules of high color, will have a better appearance than a milk with larger fat globules of lighter color, other things being equal. It is for this reason, probably, that the *lactoscope* at times gives such very erroneous results, even in the hands of skilled operators.

Proportionally there is very little *pure* milk sold in bulk which will not stand the lactometer limits of 100° to 120° at 60° F. Occasionally, however, *pure* milks are found which stand only 95° to 98° on the lactometer. Their low specific gravity is due to richness in fat, and if this is of light color the appearances easily give rise to suspicion of adulteration, while the milk may be of exceptionally rich quality. It is not a very unusual thing for pure milk, which under ordinary conditions would satisfactorily

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\* It is evident that the middleman relying upon the lactometer tests must suffer the consequences of any erroneous indication of that instrument.

stand the lactometer test, to give readings considerably too low when such milk has been drawn for long distances over rough roads. It is probable that under some conditions the milk becomes aerated through the constant agitation in the cans. At least this seems the most plausible explanation to account for differences found between the inspection tests and those made later at the laboratory and verified by the picnometer. It is possible, too, that the stem of the lactometer used by the inspector had become soiled so as to depress the instrument lower than would otherwise have been the case. In several cases the inspection tests were as much as ten degrees too low. It must be evident that the lactometer tests are not so reliable as some believe them to be, and it is essential that duplicate samples be taken for analysis to verify the lactometer. Fortunately milk vendors are no longer subject to the barbarous practice of condemning milk by the lactometer alone, without giving or retaining a sample for further examination. There is little doubt that the lactometer has brought innocent persons to grief, and it must also be acknowledged that it has passed many an habitual adulterator. *In experienced hands* it is a *useful instrument*, but is not infallible in its indications.

It may appear that the instrument is indirectly an inducement for milk vendors to adulterate their milk, for they can water and skim the milk, and by means of the lactometer adjust it to pass the inspection tests by this instrument. This is not fancy but is based upon fact, for there are persons who have been cunning enough to resort to the practice. To cite a case: Milk No. 20 in the table represents the analysis of a sample taken from a can of milk which had been subjected to skillful manipulation by one who was also caught in the act. *Unless the source of the milk and the quality of the milk yielded by that particular dairy* were known, it would be impossible for the analyst to certify, from the mere data of the analysis of the sample, that such a milk was adulterated. To show that the lactometer does not indicate the composition of the milk, reference to the following table will suffice.

TABLE OF ANALYSES,

Illustrating differences in lactometer degrees and composition of the milk :

Deg. Lact. at 60° F.	Sp. Gr.	% H <sub>2</sub> O.	Solids.	% Fat.	Cas. & Sugar.	Ash.	
1. 98°	1.0284	87.661	12.339	4.409	7.212	.718	} Pure Milk
2. 97.2°	1.0282	86.993	13.007	4.782	7.527	.698	
3. 97°	1.0281	87.094	12.906	4.860	7.346	.700	} " "
4. 98°	1.0284	88.436	11.564	3.759	7.123	.682	
5. 98°	1.0284	89.463	10.537	3.013	6.809	.715	
6. 98.2°	1.0285	88.333	11.667	3.812	7.192	.663	
7. 101°	1.0293	88.382	11.618	3.533	7.427	.658	
8. 100°	1.0290	86.620	13.380	5.239	7.521	.620	
9. 101°	1.0293	87.145	12.855	4.709	7.477	.669	
10. 100°	1.0290	89.055	10.945	3.107	7.040	.798	
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## ESTIMATION, BY TITRATION, OF DISSOLVED CARBON DIOXIDE IN WATER.

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BY ALBERT R. LEEDS.

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In the determination of the amount of lime requisite to precipitate the dissolved carbonates of lime and magnesia in natural waters, the discrepancy between the amount of carbonate remaining in solution after precipitation, and the calculated amount, is increased by failure to estimate and allow for the dissolved carbon dioxide present. This dissolved carbon dioxide interferes with the results obtained by the use of soap in the estimation of dissolved calcium carbonate. For this and many other reasons I

have laid aside the use of the soap test in the examination of waters intended for use in boilers.

The estimation of the dissolved carbonates by means of decinormal acid with methyl orange as an indicator, affords a closer approximation, and in many cases the results thus obtained agree closely with those found by gravimetric analysis. But on using the amount of lime which is required to form a neutral carbonate, the further addition of lime to saturate the free carbonic acid is the more necessary, as the waters are richer in this constituent. For the past two years I have been using the following simple method. In the case of soft waters 500 c. c. are taken, a few drops of phenolphthalein solution is added and a decinormal solution of sodium carbonate is run in until a pink tinge is obtained. This occurs when the sodium salt is changed to the bicarbonate. With hard waters 100 c. c. are sufficient. The results agree very closely with those obtained by eudiometric analysis. Thus in the case of the Hoboken water, I obtained Dec. 1st, 1890, carbon dioxide 1.03 parts; oxygen, 8.55 parts; nitrogen, 18.07 parts per 100000. This determination required, of course, the additional expenditure of time to reduce the observed results to standard pressure and temperature. By the method above given, using  $\frac{1}{2}$  litre of water, the figure directly determined for carbon dioxide was 1.01 parts.

When 500 c. c. of the water are taken, the number of c. c. of the decinormal solution used, multiplied by 2.2, gives very approximately the number of c. c. of carbon dioxide dissolved in a litre of water. If 100 c. c. of water are employed, the same result is arrived at by multiplying by eleven. Too small an amount of the indicator should not be employed, but 10 drops of a strong solution added to 100 c. c. of the water will be found sufficient.

# ON THE PRECIPITATION OF SUSPENDED CLAY BY ALUMINIC OR FERRIC HYDROXIDES, OR BY MEANS OF CALCIUM HYDRATE.

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BY ALBERT R. LEEDS.

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In many river waters there is, in addition to the coarser particles, more or less of suspended clay so finely subdivided that it readily passes through the pores of a paper or of a sand filter, unless the latter is itself of fine grain of considerable depth and the rate of filtration slow. These river waters are usually quite soft, containing but from two to six parts of dissolved carbonates of lime and magnesia. Harder waters rapidly become clear, the earthy matters not remaining in suspension when they are allowed to come to rest, whereas the soft waters may remain turbid or opalescent for weeks after the mud has precipitated and only the finest silt remains suspended.

The addition of alumina and iron salts and of lime is largely practised in order to overcome this difficulty. In order to ascertain what takes place, I have performed the following experiments upon an impure kaolin suspended in water. The kaolin experimented upon was in very minute hexagonal scales or plates, intermingled with other mineral matter. Inasmuch as kaolin is a decomposition product obtained by the weathering action of waters containing carbon dioxide in solution upon feldspars, it seemed not improbable that by reversing the action and by causing lime to react upon kaolin suspended in water, a part of the latter might be expelled and some of the lime replace the basic hydrogen. The following experiments are in accordance with this hypothesis.

An analysis was made of the material used, and its composition was found to be :

Kaolin.		Associated Impurities.
Alumina .....	15.81 %	
Ferric Oxide ....	4.87 %	
Water .....	6.675%	13.658%
Silica .....	22.25 %	26.55 %
	<hr/>	
	49.605%	Lime .....
		Undetermined ....
		4.15 %
		6.037%
		<hr/>
		50.395%

A sample of the dried kaolin, or clay, was taken weighing 0.525 gm. and diffused through a solution of lime water, containing 0.228 gm. of CaO. This was on the assumption made prior to the analysis that the kaolin was pure, and that all the combined water might be replaced by lime. After standing for a week with repeated shaking, the lime remaining in solution amounted to 0.205 gm. instead of 0.113 gm., or about 20.3 per cent. of the amount required upon the above assumption by the kaolin present.

In another experiment half a gramme of the mineral was diffused through lime water containing in solution 1 mgrm. CaO per c. c., and contained like the former in a very carefully stopped flask. After three days, 20.01 mgrms. of lime had passed out of solution.

The experiment was again repeated upon 2.5 grms. of the kaolin suspended in a half litre of water containing in solution 0.5 gm. CaO. After 30 hrs., with shaking at intervals, 0.114 gm. CaO or 29.4 per cent. had gone out of solution. At the end of 12 days an additional 19 per cent. of lime had been absorbed, or 40 per cent. in all.

For these reasons the use of lime is to be preferred where the waters need both softening and clarification, and where there is no notable amount of dissolved peaty extractive matters which impart even to the filtered waters a yellow color. In the latter case lime will not answer since it forms soluble compounds with these peaty substances, and precipitation and clarification only are attained, but attended with little or no decolorization. In such cases aluminium hydroxide is the best available reagent. The hy-



drate is thrown down by the calcium carbonate naturally present, and passes out of solution along with the co-precipitated peaty matters, the waters becoming pellucid and colorless. When fine silt is present this is removed at the same time. With kaolin suspended in distilled water artificially hardened by the addition of dissolved carbonate of lime, the kaolin was readily precipitated on the addition of an alumina salt in amount exactly equivalent to the small quantity of dissolved calcium carbonate. But it appeared to be simply entangled in the flocculi of the aluminium hydrate, and, as indeed might have been anticipated, did not enter into combination with the kaolin.

As remarked above the alum salt is necessarily used when both suspended silt and peat extract are present; iron salts will not answer. The latter behave precisely like those of alumina so far as the silt is concerned, but form soluble compounds with the peat. Indeed the color of the clarified water may be deeper than the original owing to the dark tint struck by the ferric humus compound, and when this result is obtained just as much alum salt must be employed to get rid of the dissolved iron compound and render the water colorless, as if the original peaty water itself had to be dealt with.

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## A NEW LABORATORY STAND.

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BY DR. G. C. CALDWELL.

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This stand takes the place in my student laboratory of filter stands, lamp stands and burette stands, one stand serving two students working on opposite sides of the table and carrying also a shelf long enough to hold four bottles for the reagents most commonly used in quantitative work, such as ammonia, and the acids.

It is entirely of iron, and consists of a post, with a round base about four inches in diameter and a quarter of an inch thick, from which the post proper rises to the height of about 18 inches; this post carries six arms 15 inches long, three of which can revolve towards the student working on one side of the table, while the other three revolve only in the opposite direction: above these arms is the short reagent shelf above referred to.

Four of the arms, two for each side of the table, carry iron rods which can be held at any height by the thumb screws in the ends of the arms: one of the rods carries a funnel holder like that on an ordinary filter stand, for the other rod the usual lamp rings are provided. Of course both rods can be used at once for filtration or for ignition by providing more funnel holders, or lamp rings. The third arm carries a burette holder for two burettes.

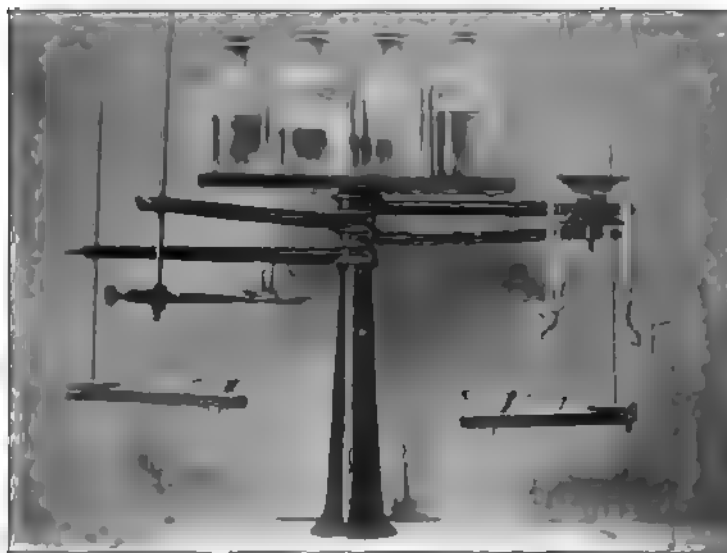
This stand has been in use in my quantitative student laboratory for eight years, as well as in my private laboratory and by my assistants in their private laboratories. When the table is built against the wall we have four-arm stands, all arms turning one way. We would not willingly go back to the old style of only movable stands, although these are occasionally required for some special purposes. Filtration, ignition and titrations can be carried on just as conveniently as with the usual appliances, and all the arrangements for these operations are perfectly stable: burettes are always plumb; at least six movable stands are dispensed with without any loss in respect to economy, as the cost of this stand complete is a little less than seven dollars.

I also use, in connection with this stand, Bunsen burners on ordinary two arm gas brackets, which, like the arms of the stand, can be drawn out towards the student working at the table, and brought under the lamp rings on the stand, and can be pushed back out of the way when not in use: thus I dispense with a large quantity of rubber tubing, avoid all danger of fire from the "striking down" of the flame of the burner, and sacrifice nothing in respect to convenience. Every student is supplied also with a burner attached in the usual manner, but he seldom uses it.

Of course this stand, working in opposite directions for two students, is incompatible with the great array of reagents that is

put before each student in nearly all quantitative laboratories. But the actual using of reagents is only a small item in quantitative work ; by far, the largest part of the time is spent in the operations of filtration, ignition or titration ; only a very few reagents have to be used frequently, and these can be counted on the fingers of one hand. With the other reagents conveniently accessible at several places in the laboratory, the loss of time incurred in going for them is insignificant ; and these occasional excursions give no little rest from the weariness of standing for a long time at one place.

The following cut of a four-arm stand needs no explanation : provision is made by four screw-holes in the base for fastening the stand firmly to the table.



## A PORCELAIN GOOCH CRUCIBLE.

BY DR. G. C. CALDWELL.

The usefulness of the platinum Gooch crucible has long since been fully established. For various reasons some way of carrying the same idea into execution in a cheaper form is desirable.

In 1882 I made some tests of a porcelain Gooch crucible with so much satisfaction, that in my next order to Gerhardt of Bonn I included crucibles of the pattern that I had been using, and they were made for me at the porcelain works. Lately these crucibles are mentioned in Gerhardt's price list. From that time on they have been in constant use by students and others in my laboratory; and this method of filtration finds much more frequent application, particularly in a student laboratory, than if we were dependent on platinum Gooch crucibles only.

Now, when platinum is so distressingly dear, it seems to be especially appropriate that a description of this crucible should be made public, together with an account of a few tests showing its equal applicability with the platinum crucible.

The crucible itself is like an ordinary number six Meissen crucible, except that all but a narrow rim of the bottom is left out. This rim supports a perforated platinum disk which must of course be heavy enough not to spring under the pressure to which it is subjected: on this disk and what is left of the porcelain bottom the asbestos welt is made in the usual manner.

The following results show that a filter made in this way holds its own as to constancy in weight as well as if made in the platinum Gooch.

Platinum Gooch :

Weight after first washing and ignition. . . . .	21.137
“ washing again with 200 c. c. of water. . . . .	21.1368
“ “ “ “ “ “ “ “ . . . . .	21.1368

## Porcelain Gooch :

Weight after first washing and ignition .....	18.0357
“ “ second with 200 c. c. water .....	18.0358
“ “ third “ “ “ “ .....	18.0358
“ “ fourth “ “ “ “ .....	18.0358

A second filter was made in another crucible:

Weight after first washing and ignition .....	18.1829
“ “ second “ 200 c. c. water .....	18.1829
“ “ third “ “ “ “ .....	18.1826
“ “ fourth “ “ “ “ .....	18.1826

A third filter was made:

Weight after first washing, with only about 150 c. c. of water after the felt was fairly made .....	18.043
Weight after washing with 150 c. c. of water .....	18.0427
“ “ “ “ “ “ “ “ .....	18.0427
“ “ “ “ “ “ “ “ .....	18.0427

## Fourth trial :

Filter first washed with about 400 c. c. of water :

Weight .....	18.835
Washed again with 150 c. c. of water .....	18.835

In order to make the test as thorough as possible the drying of the crucible was done over a direct, low flame of the gas burner, and the ignition to full redness was made with the flame playing directly on the filter. The platinum crucible was dried and ignited with the cap on.

Having observed some years ago that an ignition of a precipitate and filter could be made almost as quickly in a porcelain crucible temporarily jacketed with platinum as in a platinum crucible, I applied this idea to the porcelain Gooch crucible, by having a thin jacket spun out for it; this I find very serviceable at times, although since there is no paper filter to be incinerated its use is rarely necessary. The capacity of the number six porcelain crucible is very nearly the same as that of my platinum Gooch; but while the latter with its cap weighs about 25 grms., the platinum jacket for the porcelain crucible weigh but 10.1 grms., and is amply heavy for its purpose.

## Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

Issued January 27, 1891.

**445,164.**—Process of preserving eggs. A. Deischer.

The shell is first treated with an acid, as vinegar, and then coated with a composition of rye flour and plaster of paris.

**445,168.**—Apparatus for treating fermented liquors. W. H. Foye.

**445,211.**—Composition of matter for retarding the setting of plaster. E. Watson.

Consists of a solution of the substance of hair, and reduced to a powder.

**445,223.**—Filter. E. M. Knight.

**445,224.**—Filter. E. M. Knight.

**445,255.**—Process of making fertilizers. W. B. Seal.

The raw phosphate material is subjected to the action of sulphuric acid, and while the chemical changes are taking place, adding powdered coal and nitrogenous material.

**445,320.**—Composition for treating the surfaces of metals. J. Meese.

Consists of nickel oxide, chromate of iron, oil of stearin, oil of turpentine, and a lead glass flux.

**445,331.**—Apparatus for making anhydrous ammonia. P. J. McMahon.

**445,342.**—Process of fumigating trees and other plants. W. B. Wall, M. S. Jones, and A. D. Bishop.

Plants are fumigated with hydrocyanic acid gas in the absence of actinic rays of light.

**445,358.**—Non-conducting compound. F. Sprinkmann.

Consists of kaolin, wood pulp, and cottonseed lint.

**445,394.**—Apparatus for making coke. E. T. Cox.

**445,438.**—Tobacco smoking mixture. H. Bingham.

Consists of tobacco and asbestos.

**445,450.**—Apparatus for the manufacture of water gas. T. S. C. Lowe.

Issued February 3, 1891.

**445,528.**—Compound for frosting glass. W. H. Akester.

Consists of a solution of nitrocellulose in amyl acetate, to which has been added kaolin or other like aluminium silicate or gypsum.

**445,537.**—Apparatus for purifying water. F. A. Bunnell.

**445,567.**—Process of making acid phosphates. A. Memminger.

An improvement in making superphosphates from phosphatic material, which consists in combining the latter with an acid and a fluoride.

**445,568.**—Filter. J. H. Millen.

**445,650.**—Manufacture of lithographic plates. O. Kindermann.

Sheets of zinc are brushed with a solution of zinc chloride, tin tetrachloride, nitric acid and hydrochloric acid.

**445,684.**—Pink dye. F. Bender.

Prepared by treating tetramethyl or tetraethyldiamidophenylmethane oxide with oxidizing agents.

**445,691.**—Process of and apparatus for producing hot rolled copper free from oxidation.

The copper is passed directly from the rolls into water, to prevent contact with the air until sufficiently cooled.

**445,780.**—Apparatus for purifying water. T. J. Hoyt.

**445,815.**—Composition of matter. A. Moffatt.

A plaster or mortar consisting of cottonseed meal, linseed oil cake, ground borax, sand, plaster of paris, and water.

**445,889.**—Incombustible waste for lubricating purposes. R. R. Graf.

Consists of cotton or woolen fibre steeped in a mixture of ammonium sulphate, ammonium phosphate, sodium tungstate, ammonium chloride, sodium phosphate and water.

**445,890.**—Pressure filter. P. R. Gray and P. R. Gray, Jr.

W. R.

REGULAR MEETING, MARCH 20, 1891.

The regular meeting of the Society (postponed from March 6) was held in the law lecture room of the University Building.

The meeting was called to order at 8:15 P. M.

Vice-President Breneman in the chair.

The minutes of the February meeting were read and accepted.

The following were elected as members: C. P. Van Gundy, Eliza Furnace, Pittsburgh, Pa.; M. De Haigh, of Meyer Drug Co., St. Louis, Mo.; William Heim, East Saginaw, Mich.; Henry Heim, East Saginaw, Mich.; Prof. J. L. Jarman, Emory and Henry College, Emory, Va.; G. A. Kirchmaier, Toledo, O.; Oliver S. Ledman, 90 North High street, Columbus, O.; J. D. Pennock, Solvay Soda Co., Syracuse, N. Y.; Edw. D. Pearce, of T. P. Shepard & Co., Providence, R. I.; Prof. F. C. Robinson, Bowdoin College, Brunswick, Me.; Herbert W. Snow, of F. Stearns & Co., Detroit, Mich.; C. W. Teeter, Peoria, Ill.; E. F. Wood, Homestead Iron and Steel Works, Pittsburgh, Pa.

As an Associate: L. D. Arnold, Treas., Rumford Chem. Co., Providence, R. I.

The following gentlemen were proposed for membership:

Herbert S. Bird, N. Y. Tartar Co., Brooklyn, N. Y.

H. R. Hall, Carbon Iron Co., Parryville, Pa.

H. J. Seaman, Carbon Iron Co., Parryville, Pa.

Wm. J. Schieffelin, Schieffelin & Co., New York.

Charles E. Parker, Seabury & Johnson, East Orange, N. J.

Thos. P. Wiltshire, N. Y. Tartar Co., Brooklyn, N. Y.

As Associates:

Mr. A. P. Sharp, care Sharp & Doane, Baltimore, Md.

Dr. John B. Lynch, College Phys. and Surgeons, New York.

The following papers were then read: "Are Chemists generally prepared to abandon the Clark Test for estimation of Hardness of Waters?" By Prof. Albert R. Leeds.



After some discussion of this paper it was moved that a Committee of five be appointed to consider the hardness test for water and report to the Society.

The appointment of members of this Committee was deferred until the next meeting.

“On Condensation,” by Wm. Bernhardt. Read by the Secretary in the absence of the author.

“Some Milk Analyses,” by J. F. Geisler.

“A new form of Washing Bottle,” presented by J. H. Wainwright, was described by the Chairman in the absence of the author.

“On a Quinone Oxime,” by Dr. L. H. Friedburg. A sample of the preparation was shown.

The following miscellaneous business was then disposed of :

It was moved that a new committee be appointed to take the place of the one of last year to canvass for material for the JOURNAL. Carried.

The appointments were postponed until next meeting.

A communication from Dr. Britton, of Columbia College, upon the coöperation of scientific societies in N. Y. City was read and by unanimous vote referred to a committee of three, consisting of Messrs. McMurtrie, Waller and King, to be considered and reported upon at the next meeting.

It was voted to appoint a committee of five to recommend a table of Atomic Weights to be approved and advocated by the Society.

The chair appointed Messrs. Geisler, Friedburg, Leeds, Waller and Doremus.

The following resignations were presented : C. Elton Buck, Wilmington, Del.; John C. Sticht, 81 Maiden lane, N. Y.

The resignations were accepted with the usual proviso.

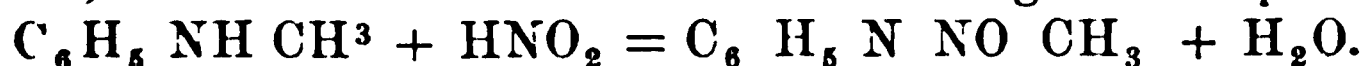
The meeting was then adjourned.

DURAND WOODMAN,  
Recording Sec'y.

# ON THE ACTION OF NITROUS ANHYDRIDE UPON ORGANIC COMPOUNDS. A NEW QUINONE OXIME.

BY L. H. FRIEDBURG.

In continuation of former papers on this subject <sup>1</sup> I present to-day a compound obtained from methyl anilin and nitrous anhydride. We shall see that under the given conditions of work <sup>2</sup> the results attained were different from those which nitrous acid would have yielded. We know that the alkyl derivatives of anilin act somewhat similarly to the secondary bases of the fatty series. Thus, a nitroso derivative is formed according to the equation:



The action of nitrous acid upon tertiary aromatic bases would lead to para compounds in which hydrogen of the benzol nucleus is replaced by the nitroso group, *e.g.*,  $\text{C}_6 \text{ H}_4 \text{ NO N (CH}_3)_2$ . This reaction, however, has so far only been realized where hydrogen of the amido group had been substituted by fatty alkyls. Applying the reaction with which we deal in these papers to tertiary aromatic bases we shall surely be led to different results. This is to be reserved for further study.

*Methyl anilin and nitrous anhydride.* The latter was diluted with ice cold  $\text{CS}_2$  and the  $\text{C}_6 \text{ H}_5 \text{ NH CH}_3$ , likewise cold, was allowed to drop into it very slowly, since even under these conditions the reaction is apt to be violent if not performed very gradually. A greenish, almost black, deposit forms at once. The mother liquor is filtered off rapidly, and the  $\text{CS}_2$  of this latter evaporated in a current of air as quickly as possible. The residue upon the filter was treated with boiling water and gradually a light

<sup>1</sup> Jour. Amer. Chem. Soc., 12, 7 and 54.

<sup>2</sup> *Ibid.*

brown body insoluble in water was obtained on the filter which readily sublimed as a yellow vapor to fine golden yellow needles, melting at  $+164^{\circ}\text{C}$ . These could also be extracted from the brown body by glacial acetic acid, less readily by ether, very easily by pure benzol and by alcohol. When these solutions were allowed to crystallize several times, golden yellow needles one inch long resulted, melting sharply at  $+163^{\circ}\text{C}$ . It was found that along with this compound had been extracted a dark orange-red substance, crystallizing from benzol in very minute golden scales. I have not, thus far, been able to obtain the nitroso reaction with phenol and conc.  $\text{H}_2\text{SO}_4$  and the crystals of melting point  $163^{\circ}$ . The individual crystals have a perfectly golden yellow appearance, but when a mass of the same is heaped together, there appears a faint olive green hue belonging to the whole. An odor but faintly recalling that of quinone characterizes this substance.

The ultimate analysis of the compound, dried for months over sulphuric acid, furnished the following results :

*0.516 grms.* gave 51, 4 c. c. N at 20,  $5^{\circ}\text{C}$ . and 754, 39 bar. The N was collected in a moist state over  $\text{KOH} + \text{aq}$ . The volume corrected for temp. and pressure = 46.3 c. c.  $N = 11, 24$  p. ct.

*0.1932 grms.* gave 0.4737  $\text{CO}_2$  and 0.0721  $\text{H}_2\text{O}$ , equal to 57.40% C and 4.14% H.

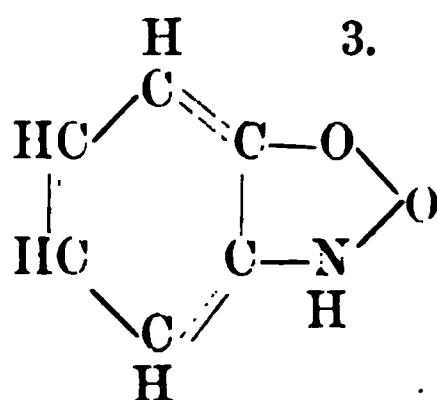
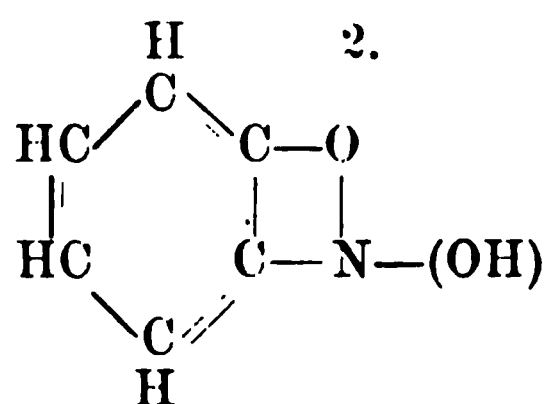
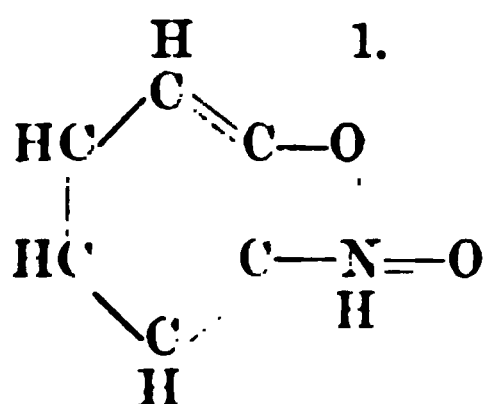
The percentage for the oxygenated substance is consequently :

Carbon.....	57.40
Hydrogen.....	4.14
Nitrogen.....	11.24
Oxygen.....	27.22
	<hr/>
	100.00

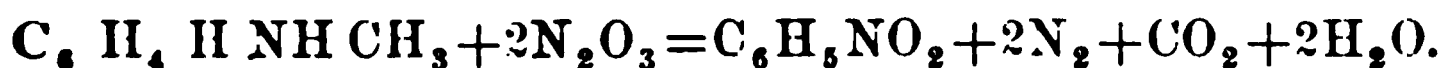
From these data is derived the simplest empirical formula  $\text{C}_6\text{H}_5\text{NO}_2$ .

Since it is evident that we have not to do here with a nitrobenzol, nor with a nitroso phenol, the required reactions not being

obtained, there remain but three possible formulæ (or isomers of them) for this remarkable substance :



The reaction that seems to have taken place may be expressed thus:



The constitutional formula (2) may prove to be the most likely expression for the substance obtained, which, I have no doubt, is a representative of that new and interesting class of bodies termed quinone oximes.

In this case and under these conditions the action of nitrous anhydride upon methyl anilin has been an oxidizing one.

The study of this substance will be continued.

NEW YORK, March, 1891.

## ARE CHEMISTS GENERALLY PREPARED TO ABANDON CLARK'S METHOD FOR ESTIMATION OF HARDNESS IN WATERS?

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BY DR. ALBERT R. LEEDS.

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At the present time, when many chemists retain and others have laid aside Clark's method, it is difficult to discover what is signified by the figures reported under hardness in a reported analysis, and it is most desirable that this obscurity should be done away with, and a uniformity of practice secured.

The objects in view, in the ordinary course of analysis, when hardness is determined, are as follows :

1st. Simply to place the water in the category of hard or soft waters. Usually private individuals desiring water analyses wish to know merely of their fitness for domestic use, and the estimation of the hardness by soap solution is adequate to supply the information needed on this point. But inasmuch as the analyst starts with an unknown water, which often turns out to be magnesian in character, or to owe part of its hardness to other constituents than lime and magnesia salts, the time expended in estimating its hardness, temporary and permanent, by soap, is greater oftentimes than that demanded by other methods.

2d. Soap destroying power. The analyst in his laboratory uses as nearly pure potassium oleate as he can prepare, and dissolves this soap in a mixture of two volumes of alcohol and one of water. His object is to so adjust his manipulation as to effect a combination of the lime and magnesia with the oleic acid, and to obtain from a table of hardness as near an approach to the actual quantities of these bodies, estimated as calcium carbonate, as possible.

To achieve this result, he frequently has occasion to dilute with distilled water and to manipulate with various refinements having no relation to the actual use of soap. For factory use the soap destroying power can best be determined by trial with the particular water and soap used ; for general purposes it can be sufficiently well estimated from the calcium carbonate equivalent deduced from titration with sodium carbonate.

Very frequently soap is used with water as hot as the hand can bear, and the valuable suggestion has been made by Mr. Herbert Jackson that on heating to  $70^{\circ}\text{C}^*$  the soap test gives the same figures as are obtained by means of dilution. Even with this device, the results vary widely in many cases from the true calcium carbonate equivalent, while they do not necessarily give soap-destroying power.

3d. Boiler incrusting solids—"scale." Hardness, however determined, should not be used in judging of the scale-forming properties, but if chemists will persist in guessing, as they do at present, the Hehner figures allow of safer guess work than those obtained by soap.

4th. Character and amount of chemicals to be added before precipitation and filtration of hardening and scale-forming substances. Ordinarily this is effected by the addition of lime, soda or soda-ash, singly or combined. Now the Hehner method in its direct determination of alkalinity before and after evaporation with sodium carbonate bears a certain analogy with the process of softening. In practice a trial should always be made using the calculated amounts of reagents, for such is the effect of the condition and relative proportions of the salts present in water, that agreement between the theoretical and actual results after treatment is frequently lacking. Still it is obtained in a fair number of cases, and much more with the soda than with the soap titration. Moreover, when soda is employed, the softening as judged by the soap test, may be apparent (so far as scale is concerned) rather than real.

What is needed, both as to scale and its prevention, is a special

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\* Chem. News, xlix., 149.

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technical study having these two objects solely in view. A method followed will be indicated in a subsequent paper.

Having stated the objections which led me several years ago to abandon the soap test, I desire to give some experiments made at that time which appeared desirable before taking this step.

In the first place are minute variations in the conduct of the test, or of the temperature, etc., sufficient to originate discrepancies between the actual amounts of calcium carbonate equivalent and those given in the table of hardness, when the test solution of calcium chloride is employed and the test is performed in the usual manner. The experiments were made with potassium oleate dissolved in 2:1 dilute alcohol and of such strength that 14.25 c.c. produced a permanent lather with 50 c.c.  $\text{CaCl}_2$  solution = 20 pts.  $\text{CaCO}_3$  per 100 c.c.

COMPARISON WITH ORDINARY TABLE OF HARDNESS. (By  $\text{CaCl}_2$ .)

Mgrms. $\text{CaCO}_3$ taken.	c. c. by Ordinary Table.	c. c. by Experi- ment.	Differences in c. c.	Mgrms. $\text{CaCO}_3$ by Experi- ment.	Differences Mgrms. $\text{CaCO}_3$ .
0.0	0.70	1.05	0.35	0.55	0.55 +
2.0	2.05	2.15	0.10	2.21	0.21 +
4.0	3.60	3.90	0.30	4.43	0.43 +
4.0	3.60	3.80	0.20	4.29	0.29 +
6.0	5.00	5.58	0.58	6.80	0.80 +
8.0	6.40	6.41	0.01	8.01	0.01 +
10.0	7.80	7.90	0.10	10.15	0.15 +
12.0	9.15	9.30	0.15	12.26	0.26 +
16.0	11.75	11.78	0.03	16.10	0.10 +
20.0	14.25	14.25	0.00	20.00	0.00

The comparison shows that these discrepancies are practically of no importance.

In the second place, is it desirable to abandon the use of the ordinary table, calculated from Clark's Table of Hardness, and,

CLARK'S METHOD FOR ESTIMATION OF HARDNESS IN WATER. 117

following a suggestion of Mr. Wanklyn, to take the equivalent of calcium carbonate directly from the soap titre minus a certain correction. For the purpose of this inquiry, I took 1.6 grms. oleic acid, exactly neutralized with decinormal soda made up to 300 c.c., and finding solution stronger than theory required, diluted until 50 c.c. water, containing the equivalent in  $\text{CaCl}_2$  of 10 mgrms.  $\text{CaCO}_3$  was exactly equivalent to 11.4 c. c. soap 50 c. c. distilled water alone was equivalent to 1.4 c. c. soap. The results were :

$\text{CaCl}_2$ sol. c. c.	$\text{CaCO}_3$ Mgrms.	Oleate Calculated.	Oleate Used.
10.0	4.0	5.4	5.40
15.0	6.0	7.4	7.40
20.0	8.0	9.4	9.45
25.0	10.0	11.4	11.40
50.0	20.0	21.4	21.50

By deducting 1.4 from the c. c. oleate used, the amount of  $\text{CaCO}_3$  equivalent is obtained directly. Were the continuance of the soap best desirable on other grounds, the testing of this method with calcium and magnesia salts, singly and combined, would have been further prosecuted.

Thirdly, Would another salt of calcium give the same results taken from the Hardness Table, as  $\text{CaCl}_2$ ?

A solution of standard  $\text{CaSO}_4 = 0.200$  gram. per litre  $\text{CaCO}_3$   
N  
was made up by adding 20 c. c. —  $\text{H}_2\text{SO}_4$  to 56 c. c.  $\text{CaO}$  solution  
10  
containing 1 mgrm. per c.c. Different volumes of this solution were made up to 50 c. c. and titrated with a soap solution of 14.25 c. c. = 20 mgrm.  $\text{CaCO}_3$  as determined with standard solution of  $\text{CaCl}_2$ .



TABLE OF HARDNESS. (By Ca SO<sub>4</sub>.)

CaSO <sub>4</sub> = CaCO <sub>3</sub> mgrms used.	c. c. by ordinary Table.	c. c. by experiment.	differences in c c.	mgrmsCaCO <sub>3</sub> by experiment.	differences mgrms CaCO <sub>3</sub> .
0.0	0.70	1.05	0.35	0.55	0.55+
2.0	2.05	2.10	0.05	2.08	0.03+
4.0	3.60	3.60	0.00	4.00	0.00
6.0	5.00	5.00	0.00	6.00	0.00
8.0	6.40	6.40	0.00	8.00	0.00
10.0	7.80	7.80	0.00	10.00	0.00
16.0	11.72	11.70	0.02	15.95	0.05—
20.0	14.25	14.10	0.15	19.76	0.24—

A solution of CaCO<sub>3</sub> in CO<sub>2</sub> water was made with the view of holding as little free CO<sub>2</sub> as possble. 50 c. c. = 20 mgrms. Ca CO<sub>3</sub> = 13.6 c. c. soap solution = 18.97 mgrms. of CaCO<sub>3</sub> per table. Further experiments showed that distilled water containing increasing amounts of dissolved CO<sub>2</sub> give corresponding differences from the titre obtained with Carbonic acid free water.

Fourth. Could a magnesium salt be made to give results corresponding to the equivalent CaCO<sub>3</sub> as taken from the table?

50 c.c. MgSO<sub>4</sub> sol. = 20 mgrms. CaCO<sub>3</sub> was titrated with soap run in 1 c. c. at a time and with much shaking. It gave no satisfactory end reaction but an apparent permanent lather at about 12 c. c. instead of 14.25 c. c.

Repeated with intervals of three minutes between each c. c., an unsatisfactory end reaction was obtained with 10 to 12 c. c.

25 c. c. MgSO<sub>4</sub> + 25 c. c. water was titred as follows :

First : 6 c. c. with 1 c. c. at 2 minute intervals.

6.7 c. c. at 5 minute intervals.

7.1 to 7.5 c.c. at 5 minute intervals.

7.5 not normal lather : 7.6 nearly normal.

7.6 to 7.8 c. c. at three 5 min. intervals.

The whole operation required an hour and the final result with a normal lather yielded 7.8 c. c. = 10 pts. per 100,000. In another experiment with less time and shaking 8.4 c. c. were used,

and the final outcome shows that with sufficient care and patience an agreement can be obtained in the case of magnesium salt (1 mol. CaO=1 mol. MgO) with theoretical figures up to the equivalent of 10 parts CaCO<sub>3</sub> per 100,000. But a method which necessitates so great an expenditure of time, labor and care to obtain results that only in certain cases are approximately correct, should, it appears to me, be abandoned.

The results were as follows :

TABLE OF HARDNESS. (By MgSO<sub>4</sub>.)

MgSO <sub>4</sub> = CaCO <sub>3</sub> mgrms.	c. c. by Table.	c. c. by experiment.	differences in c. c. .	mgrms. CaCO <sub>3</sub> by experiment.	differences mgrms.
2.00	2.00	2.10	0.10	2.08	0.08+
4.00	3.60	3.60	0.00	0.00	0.00
6.00	5.00	5.03	0.03	6.03	0.03+
8.00	6.40	6.65	0.25	8.35	0.35+
10.00	7.80	7.80	0.00	0.00	0.00
10.00	7.80	8.40	0.60	10.90	0.90+
20.00	14.25	12.00?			
20.00	14.25	10 to 12?			

In conclusion, I would ask whether the members are prepared to take formal action, and to recommend a rule of practice in estimating and reporting upon what shall be conventionally styled the "Temporary" and "Permanent" Hardness.

## MILK ANALYSES.

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BY JOSEPH F. GEISLER.

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In presenting this short paper on the monthly analysis of the milk of a herd of cows I desire briefly to call attention to a few factors which deserve consideration in the production of milk.

Variations in the quality of milk are widest in the milk from individual cows, while milk from a herd of cows approaches more nearly a common average in composition. Aside from the number of cows which may have contributed to a given sample of milk, it is a known fact that the quality of the milk is directly affected by the breed of the cows, the condition of their health and surroundings, the time since the last parturition, the character as well as the quality and quantity of the food, and also to some extent the season and atmospheric conditions.

All cows will not produce equally good milk from the same class of fodder, and strange as it may seem it is reported upon good authority that a certain herd of cows produced a poor quality of milk as a direct result of overfeeding. The milk improved in quality when the quantity of fodder was properly regulated.

In the following table are given the monthly analyses of the milk from a herd of about twenty-five cows kept at Washingtonville, Orange Co., New York. The samples submitted to me were fair average samples for the days of the respective months and the data will give a fair idea of the variations to be expected in the milk from a herd of common native cows kept in good condition and subsisting on the character of fodder as noted in the accompanying table. On five occasions I was enabled to obtain the morning milk and the evening milk of the preceding day. Evening milk is generally somewhat richer in fat than the morning's milk, but in two of these cases the variation was very slight. It would have been interesting to know the exact yield of milk but

I was unable to obtain the data. In thirteen of the samples the milk sugar was estimated and the casein and albumen by difference. The average for milk sugar was 5.05% and for the casein and albumen 3.02%, the quantities fluctuating but very little from these averages. The fat was in all cases estimated by the Adams or *coill* method (see Jour. Amer. Chem. Soc., 12, 488). For the taking of samples and the data as to feeding I am indebted to the kindness of Mr. F. D. Tuthill, Assist. N. Y. State Dairy Commissioner.

## MONTHLY ANALYSES OF PURE HERD MILK.

When taken.	Sp. Gr. at 60° F.	Water. %	Total Solids.	Fat. %	Casein % & Sugar.	Ash. %	Solids Not Fat
1890.							
Jan. 11th, a. m.	1.0321	89.074	12.926	4.297	7.861	.768	8.629
Feb. 16th, p. m.	1.0310	86.977	13.023	4.396	7.899	.728	8.62
Feb. 17th, a. m.	1.0324	87.308	12.692	3.777	8.184	.731	8.91
March 16th, p. m.	1.0326	86.944	13.056	4.222	8.119	.715	8.83
March 17th, a. m.	1.0331	86.614	13.386	4.212	8.414	.760	9.17
April 13th, p. m.	1.0311	87.377	12.623	4.058	7.820	.745	8.56
April 14th, a. m.	1.0321	87.094	12.906	4.110	8.044	.752	8.79
May 25th, p. m.	1.0322	86.969	13.031	4.347	7.959	.725	8.68
May 26th, a. m.	1.0319	87.200	12.800	3.937	8.135	.728	8.86
June 14th, a. m.	1.0319	87.422	12.578	3.697	8.160	.721	8.88
July 21st, a. m.	Not taken	87.546	12.454	3.878	7.836	.740	8.57
Aug. 18th, a. m.	1.0318	87.155	12.845	3.890	8.195	.760	8.95
Aug. 24th, p. m.	1.0312	87.152	12.848	4.181	7.928	.739	8.66
Aug. 25th, a. m.	1.0313	87.558	12.442	3.716	7.990	.736	8.72
Sept. 22d, a. m.	1.0313	87.255	12.745	3.917	8.088	.740	8.82
Oct. 14th, a. m.	Not taken	87.045	12.955	4.021	8.182	.752	8.93
Nov. 24th, a. m.	1.0323	87.192	12.808	4.001	8.037	.770	8.80
Dec. 16th, a. m.	1.0321	87.299	12.701	3.955	7.995	.751	2.74

## DAILY FODDER RATIONS.\*

January 1890,  $\frac{1}{2}$  Bushel Brewery Grains, 4 qts. Bran, 2 qts. Hominy Meal.

February, 1890,  $\frac{1}{2}$  Bushel Brewery Grains, 4 qts. Bran, 2 qts. Hominy Meal.

\* During the Winter months the cows had all the hay they wanted.

March 1890,  $\frac{1}{2}$  Bushel Brewery Grains, 4 qts. Bran, 2 qts. Hominy Meal.

April, 1890,  $\frac{1}{2}$  Bushel Brewery Grains, 4 qts. Bran, 2 qts. Corn Meal.

May, 1890, Grass alone.

June, 1890, " "

July, 1890, " "

August, 1890, Grass and  $\frac{1}{2}$  Bushel Brewery Grains.

September, 1890, " " " " " "

October, 1890, " " " " " " 4 qts. Bran.

November, 1890, " " " " " " 8 qts. Bran.

December, 1890, " " " " " " 8 qts. Bran.

## ON CONDENSATIONS.

BY WM. BERNHARDT.

It was with deep interest I have read Dr. T. Sterry Hunt's paper on "mineral condensation," published in this journal and reprinted in the *Chemical News*, but, whilst accepting most of his views, it has seemed to me, that what is commonly called "condensation" is an expression comprising processes of very different kind, and of strongly distinguished characters. For instance, formaldehyde and the products of its condensation exhibit the distinctions between "condensation" in the strict sense of the word and identical with "polymerisation," and ordinary condensation, by which compounds result that cannot strictly be considered as polymers of the original substance. Formaldehyde when kept for some time is partly transformed into solid para-formaldehyde, from which by applying heat formaldehyde may easily be regenerated. Not so from the sugars which result from treating the aldehyde with milk of lime, or with tin shavings. Although their aldehydic character can scarcely be denied and is manifested in the formation of alcohols under the influence of

nascent hydrogen, the reproduction of formaldehyde from them has not yet been performed, and it is doubtful if it ever can be performed. Condensation in the strict sense of the term should include the possibility of regenerating the original substance, a possibility which is lacking in the case of formose and similar sugars. Moreover, paraldehyde is a true product of condensation. I consider sulphur, phosphorus and arsenic, when solidified from their vapor, liquid chlorine obtained by cooling or compressing the gas, water, and, in short, all elements and compounds in the solid or liquid state directly convertible into their primary forms. The formula of common crystalline phosphorus in respect to the density of its vapor would be  $P_{333}$ , as becomes apparent from the following calculation, in which, however, neither the expansion by heat of the vapor nor that of the solid substance has been considered.

1 litre of hydrogen weighs 0.0897 grm.

1 " " phosphorus vapor (sp. gr. 62) =  $62 \times 0.0896$

1 " " " " contains 5.555 grms. of solid phosphorus

Sp. gr. of solid P. (water = 1) is 1.830

1.830 grm. solid P. therefore fills the volume of 1 c. c. of water.

Then by the proportion :

1.830 : 1,000 :: 5.555 ..  $x$

We find  $x = 3$  c. c. meaning that 3 c. c. of solid phosphorus, when converted into vapor, fills the volume of 1 litre. Condensation ensues in the proportion of 1,000 : 3 = 333 : 1. 333 is the coefficient of condensation of phosphorus, its formula therefore  $P_{333}$ .

The complex nature of both solid and liquid elements becomes evident by calculations of this kind. To crystallized elementary arsenic a formula of about  $As_{425}$ , and to mercury of  $Hg_{1515}$  should be given. 1,696 volumes of the vapor of water yield 1 vol. of liquid water ; water therefore ( $H_2O$ ) is 1696.

Condensation, as appears from the instance of water, does not always take place in the order of gas, liquid, solid, but the liquid state may be of greater density than the solid one. Solid cast iron also swims upon the surface of the molten metal. In chloral,

upon addition of a small quantity of water, solidification ensues, chloral hydrate resulting; it is questionable, however, whether this process may be classified as a "condensation," the product, although solid, being of less spec. gravity than chloral.

As to most of the metals, their oxides and salts, we are entirely at a loss to determine their real molecular weights, calculation of them from the density of their vapor being only possible in the comparatively few cases which permit of volatilization; there seems to be little doubt, however, that in their formation condensation is mostly combined with a chemical change excluding the possibility of restoring the original substance by simple physical means. Such changes generally occur in the formation of precipitates; they are especially evident in the decomposition of neutral bismuth and antimony salts by water. Still there are various exceptional cases, in which, by applying or withdrawing heat, a precipitate already formed is again dissolved. Most soluble salts are more readily dissolved by warm than by cold water; calcium citrate, on the contrary, readily dissolved by cold water, is precipitated by heating the solution. There can be little doubt that in such cases some chemical change occurs, a soluble combination of calcium citrate and water existing, which is decomposed by heat, but restored on cooling. A similar change occurs, when a solution containing calcium tartrate and potassium hydroxide is heated.

Heat is one of the mightiest promoters of chemical combination on the one hand, of decomposition on the other, and is indeed the chief agent in most chemical processes; furthermore, the doctrine of thermo-chemistry is founded upon the appearance or disappearance of heat in every disturbance of chemical equilibrium. Still, heat has always been considered as a physical force, and the modern kinetic theory regards it as a kind of movement which, when transferred to the molecules of any substance, may induce chemical alterations, also consisting of particular kinds of motion. These reasons entitle us to distinguish the effects of heat from those of other chemical agents and to classify the products of condensation in the following way:

1. *Physical condensation* or *polymerisation* consists in an aggregation of atoms in a molecule, by which, the constituents and their

percentage remaining unaltered, a complex molecule is formed, from which, however, by the application of heat the original molecule can be restored. For example, sulphur, phosphorus, arsenic, mercury, chlorine, iodine, bromine, water, paraldehyde, metaldehyde, etc.

2. *Chemical condensation* consists in an aggregation of atoms in a molecule, which, together with changes of the atoms as to their relative position and of the molecular structure, produces a complex molecule, from which by means of heat the primary molecules cannot be restored. For example, many insoluble precipitates of metallic compounds, fixed solid elements and compounds in general.

It is hoped that these few suggestions may contribute to a more precise understanding by the expression "condensation," and may separate such natural processes into classes of different character.



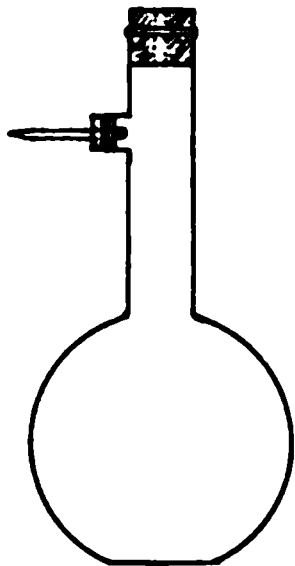
## THE CHAPMAN WASHING BOTTLE.

(COMMUNICATED BY J. H. WAINWRIGHT, Ph. B.)

A reference to the figure will explain the new form of wash bottle suggested by Mr. E. J. Chapman, of the U. S. Laboratory.

It consists of an ordinary tubulated flask, such as is used for distillations, fitted with two soft rubber stoppers each having a single perforation, as shown.

The spout, consisting of a small piece of glass tubing drawn out as usual, is inserted in the stopper on the side of the neck and the bottle is used by simply pouring the washing liquid from the spout, keeping the thumb applied to the perforation in the cork closing the neck.



The stream delivered can thus, with a little practice, be very nicely regulated from single drops to a steady stream, as desired.

The simplicity of this little piece of apparatus and the readiness with which it can be made from the ordinary materials at hand in almost any laboratory render it especially convenient, and it will be found particularly useful in the employment of such solutions as ammonia, molybdate solution, etc.

## Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

Issued February 10, 1891.

**445,977.**—Pad for rapid copying. Louis Neuhaus and Felix F. Daus, New York, N. Y.

Pad composed of mixture prepared by mixing three parts of dry and powdered china clay No. 1, one part of French powdered chalk and one-half part of plaster of paris, and adding to this mixture, by kneading or otherwise, the composition resulting from mixing three-quarter parts ordinary starch, three-quarter parts dissolved dextrine, one sixty-fourth part of chloride of calcium in the pure crystal, one-sixteenth part of ordinary sugar, and one and one-quarter part of liquid glycerine.

**445,982.**—Apparatus for the reduction of petroleum into gas. Fritz Dürr, Munich, Germany.

**446,004.**—Method of producing colored impressions. Robert Schorr, Würtemberg, Germany.

**446,009.**—Yellow dye. William Pfitzinger, Elberfeld, Germany.

A dye prepared by treating the diazo compound of thioparatoluidine sulpho-acid with the sulpho-acid of the same thio derivative of the paratoluidine.

The coloring is easily soluble in water with a clear greenish-yellow color, turning red on the addition of acetic acid, precipitating as a red powder by adding mineral acid; it is destroyed by concentrated sulphuric acid or boiling diluted mineral acid with evolution of nitrogen, and it dyes unmordanted cotton a bright greenish yellow in alkaline soap bath.

**446,018.**—Paint from residuum of vegetable oils. George W. Scollay, New York, N. Y.

**446,019.**—Art of making paint. George W. Scollay, New York, N. Y.

**446,021.**—Apparatus for storing and preserving food. Lyman Smith, Chicago, Ill.

An hermetically sealed box, in which food can be treated with carbonic acid.

**446,041.**—Paper pulp boiler. Solomon R. Wagg, Appleton, Wis.

**446,046.**—Photographic camera. Frank Whitney, Chicago, Ill.

**446,050 and 446,051.**—Apparatus for dyeing straw goods, etc. James A. Young, Boston, Mass.

**446,055.**—Ore concentrator. Marcelin Castelnau, Paris, France.

**446,060.**—Apparatus for making sulphuric acid. Emil Delplace and Jules Delplace, Aubervilliers, France.

**446,064.**—Brick machine. Collier V. Hemenway, Wellington, Ohio.

**446,077.**—Machine for liquidizing milk. George Roth, Highland, Ill.

**446,087.**—Phosphate and process for making the same. Joseph Van Rumbeke, Chicago, Ill.

Iron and alumina phosphate are first treated with sulphuric acid, then treated at a temperature of 400°–800° Fahr., until the acid phosphate is changed into metaphosphate, usually indicated by the product assuming a gray color.

**446,088.**—Nitrogenous fertilizer. Joseph Van Ruymbeke, Chicago, Ill.

**446,117.**—Process of and apparatus for purifying grease. George Race, Norwich, N. Y.

The grease is floated while in a liquid state over currents of water running in the opposite direction and jets of steam and air are forced successively through the water and liquid grease.

**446,145.**—Roofing paper. Henry Cunningham, Bachtown, Ill.

A roofing paper having a coating of linseed oil and charcoal.

**446,149.**—Sizing apparatus for slime, etc. Carl A. E. Mimicke, Clausthal, Prussia, Germany.

**446,153.**—Filter. John S. Roake, Brooklyn, N. Y.

**446,191.**—Decorating sheet metal for ceilings, etc. Edward Püttmann, Schivelm, Germany.

**446,205.**—Ice machine. Edward J. Hardy, Brooklyn, N. Y.

**446,248.**—Milk testing and separating machine. Dyer Cooper, Philadelphia, Pa.

**446,252.**—Freezing apparatus. Jacob Erny, Zach. T. Subers, William Hoos, Philadelphia, Pa.

**446,265.**—Wall and ceiling polish. Thomas J. Neavitt.

Composed of white spirits of turpentine, light colored mastic, and light colored sandarac in equal quantities, oil of lavender, powdered glass, and white oil of poppy..

**446,285.**—Disinfecting paving composition. John Fottrell, New York, N. Y.

**446,294.**—Method of preparing water proof material. Harry A. Schlesinger, London, England.

**446,344.**—Lubricating oil. Robert R. Graf, Baltimore, Md.

A fireproof lubricating oil consisting of a mixture of an ordinary lubricating oil with sodium tungstate, ammonium sulphate, ammonium phosphate, sal ammoniac and sodium monocarbonate.

**446,351.**—Aluminum alloy. John A. Jeancor, Newport, Ky.

A bronze or alloy of copper, aluminum and manganese in about the proportions of seventy-five to eighty-five per cent. of copper, twelve to twenty-five per cent. of aluminum, and two to five per cent. manganese.

**446,382.**—Composition for plastering. Reuben G. Farnham, Elbridge. Composed of jute, Portland cement and marl.

*Issued February 17th, 1891.*

**446,458.**—Cement for joining the ends of driving belts. Carl Löchert, Berlin, Germany.

A mastic or cement for joining straps or driving belts, consisting of a mixture of glue, vinegar spirit, alum, spirits of turpentine, shellac and potassium chromate.

**446,469.**—Milk testing device. Alban H. Reed, Philadelphia, Pa.

**446,500** and **446,501.**—Apparatus for vulcanizing wood. James P. White row, Pittsburg, Pa.

**446,502.**—Composition of matter for cable-filling. Edward G. Wright, Kansas City, Mo.

The composition consists of crude petroleum, tallow, gypsum, whiting, pine tar and paraffine wax.

**446,505.**—Composition for combustible briquettes. Hayden M. Baker, Brooklyn, N. Y.

Composition consists of finely divided organic waste, a sodium di- or trisilicate in aqueous solution and of a sp. gr. of 30°—65° Beaumé, and an alkaline nitrate or its described equivalent.

**446,527.**—Secondary battery. Arthur M. F. Laurent-Cély, Paris, France.

"The process of forming material for secondary battery plates, consisting in fusing or melting lead chloride, adding metallic zinc thereto, and subsequently running the mass into a large receiver and allowing the impurities of the mixture to fall to the bottom of receiver," etc.

**446,544.**—Battery compound. William Wright, New York, N. Y.

An electrolyte containing a salt of alumina or other aluminum compound treated with sulphuric acid and sodium bichromate.

**446,572.**—Dyeing vat. Josiah R. Proctor and William B. Keefer, Philadelphia, Pa.

**446,604.**—Composition of matter for restraining the setting of plaster compounds. Edward Watson, Grand Rapids, Mich.

The composition consists of a leguminous substance, such as peas, beans, lentils, etc., slaked lime, sodium carbonate, an alkaline earth, or a salt of an alkaline earth, or a salt of a caustic alkali.

**446,651.**—Extractor churn. Adolph Wahlin and Carl Lundström, Stockholm, Sweden, and Thomas Collins, Winchester, N. H.

**446,652.**—Apparatus for making sulphite lye. Alexander Wendler and Jul. Spiro, Watertown, N. Y.

**446,654.**—Compound for paving, roofing and building purposes. Henry F. Williams, San Francisco, Cal.

Consists of a mixture of asphalt and refined lard or lard oil.

**446,658.**—Ore or rock breaker. Charles G. Buchman, Rockaway, N. J.

**446,660.**—Carbon for electric lamps. William H. Burns, Los Angeles, Cal.

Composed approximately of ninety parts of triturated purified maltha coke and ten parts of semi-liquid purified maltha thoroughly incorporated therewith.

**446,669.**—Manufacture of filaments for incandescent electric lamps. Thomas A. Edison, Menlo Park, N. J.

**446,683.**—Method of coloring clay ware. Gustav Hotlinger, Chicago, Ill.

The method consists in introducing into the kiln after the burning of the ware is complete a coloring agent in a liquid form and in the presence of a moistened atmosphere.

**446,706.**—Amalgamating apparatus. Thomas Gemmel, London, England.

**446,727.**—Pyro-chemical battery. John Blair, North Orillia, and Alex. G. Hunter, Dundalk, Ontario, Canada.

**446,815.**—Process of making alkaline phosphates. Charles Glaser, Baltimore, Md.

A salt of an alkali and an acid volatile at higher temperature are fused with crude commercial phosphoric acid in excess of an amount required to form a pyro-phosphate; secondly, the fused mass is dissolved in water and boiled until conversion of meta and pyro-phosphoric acid is effected; thirdly, the product is treated with the carbonate of an alkali (or free alkali) till alkaline reaction is obtained, and finally the solution is filtered and the salts are crystallized.

**446,818.**—Marine paint. John N. Longden, New York, N. Y.

Moist precipitated copper is incorporated with a paint vehicle and the mixture stirred at a temperature sufficiently high to drive off the water.

*Issued February 24th, 1891.*

**446,845.**—Artificial fuel. Isidore C. Bandman, Atlanta, Ga.

A compound composed of fragments of coal or other similar solid fuel cemented into a block by means of an inflammable compound composed of rosin, sawdust and black or peroxide of manganese.

**446,854.**—Dyeing machine. Joseph P. Delahunty, West Pittston.

**446,860.**—Covering for steam or hot water pipes. Charles E. Gilman, Eldora, Iowa.

The covering consists of burned porous earthenware having incorporated therein an incombustible fibrous mineral substance, the covering being united to the pipe by a layer of cement.

**446,875.**—Compound of iodine with thymol. Joseph Messinger and George Vortmann, Aix-la-Chapelle, Germany.

"A new iodine substitution product of thymol, which is an amorphous odorless powder of a brown-red color, insoluble in water and alkali and difficultly soluble in alcohol, more easily in ether, and easily in oil, melting at about 110° centigrade under decomposition.

**446,877.**—Composition for coating bricks. John Miller, Cincinnati, Ohio.

Compound composed of beeswax, paraffine, and an alcoholic solution of shellac.

**446,887.**—Preparing food from milk curd. Albert W. Rehnström, Mülhausen, Sweden.

**446,892.**—Alizarine Derivative. Robert E. Schmidt, Elberfeld, Germany.

Derivative obtained by "oxidizing alizarine bordeaux (tetraoxanthraquinone) in sulphuric acid solution with oxidizing agents, such as manganese or arsenic acid, then boiling, filtering and washing and subsequently dissolving the precipitate in hot dilute alkali and filtering and precipitating the coloring matter with acid.

The coloring matter said to form a red-brown paste, or when dried a brown powder, insoluble in water, easily soluble in soda lye with blue color tinged with violet; it dissolves in concentrated sulphuric acid with a pure blue, the solution showing a beautiful fluorescence, and in glacial acetic acid or alcohol it dissolves with a more yellowish or bluish-red color of moss-green fluorescence and crystallizes from it in beautiful dark or blackish-brown glittering needles.

**446,893.**—Alizarine Derivative. Robert E. Schmidt, Elberfeld, Germany.

Obtained by oxidizing dried alizarine (dioxanthraquinone) with large quantities of fuming sulphuric acid of a high percentage of anhydride at a low temperature, pouring the melt on ice and filtering the intermediate product from the yellowish-brown deposit formed, dissolving the same in soda-lye, and adding diluted mineral acid to the boiling solution to precipitate the coloring matter; this is a yellowish red paste insoluble in water, easily soluble in soda-lye and in concent. sulphuric acid with a blue-violet color, and crystallizing from glacial acetic acid or nitro benzole in garnet-red needles not melting at 280° C, and having the composition  $C_{14}H_8O_8$ .

**446,911.**—Process of manufacturing Portland cement. Henry C. Baum, Denver, Colo.

Wet marl is united with quicklime whereby the mixture resulting from the chemical reaction is rendered perfectly dry preparatory to grinding.

**446,922.**—Fireproof paint. Isaac L. Merrell, San Francisco, Cal.

The composition consists of "aluminum, asbestos, soapstone, sodium silicate, magnesia, mica, fireproof clay, lime water, and a cohesive liquid, such as glue in solution, with or without coloring matter or substance.

**446,971.**—Roasting and smelting furnace. William Heckert and others, Findlay, Ohio.

**446,988.**—Chemical retting and ungumming of textile fibres. Charles De La Roche, Paris, France.

**446,996.**—Ore roasting furnace. George N. Phelps, Brooklyn, N. Y.

**446,998.**—Making phosphatic fertilizers. Joseph Van Ruymbeke Chicago, Ill.

Iron and alumina phosphate are pulverized, mixed with muriate of potash, or preferably low grade sulphate of potash, the mixture treated with sulphuric acid and then subjected to heat until the acid phosphate contained therein is converted into metaphosphate.

**447,068.**—Process for making artificial cryolite. Englebert Richters, Sauran, Germany.

**447,087.**—Process of printing in colors. William Schumacher, Brooklyn, N. Y.

**447,121.**—Sticky fly paper. Henry W. Stecher, Cleveland, O.

**447,181.**—Process of making malt liquor. John Griffiths, Brooklyn, N. Y.

**447,188.**—Artificial fuel. Rudolph J. Schimpeo, Jersey City, N. J.

Powdered charcoal saturated with solution of lead acetate, with lime and gypsum, and compressed into blocks.

**447,155.**—Apparatus for the calcination of cement. Paul Krotnaurer, White Hall, Pa.

**447,189.**—Red dye. Paul Julius, Ludwigshafen-on-the-Rhine, Germany.

Substantive red dyestuff (sodium salt of diamidodiphenyleneketoxime diazo-naphthionic acid) which appears in the form of a dark colored powder giving a brown streak on rubbing. It is readily soluble in both cold and hot water, yielding bluish red solutions; it is almost insol. in alcohol even on boiling; insol. (or practically so) in benzine and ether; it dissolves readily in conc.  $H_2SO_4$  giving blue solution, which on addition of water gives a blue precipitate. Calcium chloride gives a brownish red precipitate and copper chloride a dark brownish purple one.

J. F. G.

REGULAR MEETING, FRIDAY, April 3d, 1891.

Vice-President, Prof. Breneman in the chair.

In the absence of the Recording Secretary, Mr. Geisler was appointed Secretary, *pro tem*.

The minutes of the previous meeting were read and approved.

The minutes of the meeting of the Board of Directors, of March 31st, were read and approved.

The following new members were elected : Herbert S. Bird, N. Y. Tartar Co., Brooklyn, N. Y.; H. R. Hall, care of Carbon Iron and P. Co., Parryville, Pa.; Charles E. Parker, East Orange, N. J.; Wm. J. Schieffelin, care of Scheffelin & Co., N. Y.; H. J. Seaman, care of Carbon Iron and P. Co., Parryville, Pa.; Thos. P. Wiltshire, care of N. Y. Tartar Co., Brooklyn, N. Y.

As associates: Dr. John B. Lynch, Coll. Physicians and Surgeons, N. Y.; A. P. Sharp, care of Sharp & Dohme, Baltimore, Md.

The following names were proposed for membership : C. S. Boynton, A. L. Kennedy, Geo. W. Riggs, G. W. Roberts, E. D. Williams.

For associate membership : A. O. Ingalls.

The reports of Committees being next in order, the chair announced the Committee on Investigation of Tests of Hardness of Waters, etc., the appointment of which was ordered by vote at the March meeting, as follows : A. R. Leeds, J. W. Mallet, C. A. Doremus, E. Waller, A. A. Breneman.

As Committee on Contributions to the Journal : Wm. McMurtrie, G. F. Barker, G. C. Caldwell, E. Waller, A. R. Leeds.

The following papers were then read :

“On Some Analyses of Coal,” by Dr. C. E. Munsell.

“On the Effect on Butter of Feeding Cotton Seed Oil,” by Prof. N. T. Lupton ; read by the acting Secretary.

“On Acid Calcium Tartrate,” by Dr. L. H. Friedburg.

“On Methyl Iodide,” by Dr. L. H. Friedburg.

The meeting was then adjourned.

J. F. GEISLER,

Rec. Secretary *pro tem*.



## THE EFFECT ON BUTTER FROM FEEDING ON COTTON SEED AND COTTON SEED MEAL.

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BY PROF. N. T. LUPTON.

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An investigation was undertaken a few months ago at the Alabama Experiment Station to determine the effect of cotton seed and cotton seed meal on the composition of the butter fat, especially on the volatile acids, the melting point, and the specific gravity of the butter produced.

Several chemists of late years have called attention to changes produced by the use of the feed stuffs mentioned, notably Prof. Harrington, of the Texas Experiment Station and Dr. Wiley, of the Department of Agriculture, Washington, D. C. This subject was thought to be of sufficient scientific and practical importance to justify an extended investigation. For this purpose, a herd of registered Jerseys was divided into two groups, one consisting of ten cattle and the other of a single cow. The cattle of the first group were fed for a preparatory period of ten days on the customary ration used at the station, excluding cotton seed meal and hulls, the single cow was fed on the same ration. At the end of the preparatory period, samples of milk and butter were taken for one week, on Monday, Wednesday and Friday, and carefully analyzed. The milk of the ten cattle composing the first group was mixed and churned as a whole, that of the single cow was kept separate and churned by itself. The first preparatory period was for ten days; after that, the experimental and preparatory periods extended over seven days each.

The daily rations for the different periods which represent the kind and quantity of food actually consumed, were as follows:

1st Period, preparatory and experimental.

Ground oats.....	5 lbs.
“ corn .....	5 “
Bran .....	5 “
Nutritive Ratio.....	1:5.8.

2d Period.

Cotton seed meal.....	3 lbs.
Ground oats.....	4 “
Bran .....	5 “
Ensilage.....	11
Nutritive Ratio.....	1:3.75.

3d Period.

Cotton seed meal.....	4 lbs.
Cotton seed hulls.....	9 “
Ensilage.....	4½
Nutritive Ratio.....	1:5.08.

During the fourth period, the cattle were confined exclusively to raw cotton seed and cotton seed hulls; and during the fifth period to cooked cotton seed and cotton seed hulls. They were allowed as much as they would eat. The nutritive ratios mentioned above are calculated from analyses made of the feed stuffs in use at the station. In compounding the rations, the object was not so much to conform with strictness to the German standard as to bring the cows gradually under the influence of cotton seed, cotton seed meal, and hulls, without injury to their general health.

The results of the analysis of samples of milk and butter, taken immediately after each milking and churning, are given below. The first two tables give the composition of each sample of milk analyzed, also the volatile acids, melting point, and specific gravity of the butter from the same milk; the third table gives the average composition for each experimental period.

Composition of Jersey Milk for each day analyzed.						Butter from same Milk.			
DATE.	Water.	Butter Fat.	Casein.	Sugar.	Ash.	Volatile Acids.	Melting Point.	Specific Grav. at 100° C.	Rations.
Group I.	Pr Ct.	Pr Ct.	Pr Ct.	Pr Ct.	Pr Ct.	Expressed in c. c. one-tenth normal alkali for 5 grms. of fat.	C°.		
Nov. 19...	85.76	5.58	3.95	3.96	0.80	30.0	35° 9	0.90257	} <i>Period I.</i> 5 lbs ground oats.
" 21...	84.95	5.20	4.05	5.09	0.81	29.6	35° 8	0.90811	
									} 5 lbs ground corn. 5 lbs. bran.
Dec. 1....	84.15	5.73	4.06	5.24	0.82	29.7	36° 0	0.90411	
" 3....	83.62	5.51	3.88	6.19	0.80	30.5	36° 8	0.90165	} <i>Period II.</i> 3 lbs cotton seed meal. 4 lbs ground oats.
" 5....	84.26	5.16	3.90	5.98	0.80	31.4	36° 1	0.90265	
									} 5 lbs. bran. 11 lbs. ensilage.
" 15...	84.53	5.96	3.64	5.12	0.75	28.4	36° 6	0.90081	
" 17...	83.85	6.07	3.60	6.03	0.75	26.9	37° 6	0.90194	} <i>Period III.</i> 4 lbs. cotton seed meal. 9 lbs. cotton seed hulls.
" 19...	84.71	5.79	3.57	5.19	0.74	27.1	38° 1	0.90306	
									} 4½ lbs. ensilage.
Jan. 5....	84.27	6.41	3.58	5.01	0.73	22.0	43° 6	0.90021	
" 7....	84.59	6.11	3.34	5.22	0.74	21.9	43° 9	0.89721	} <i>Period IV.</i> Raw cotton seed Cotton seed hulls.
" 9....	84.51	5.84	3.56	5.37	0.72	22.4	43° 4	0.89955	
									} <i>Period V.</i> Cooked cotton seed. Cotton seed hulls.
" 19...	85.84	4.87	3.39	5.16	0.74	23.1	42° 7	0.90462	
" 21...	84.89	5.95	3.31	5.06	0.77	22.2	42° 8	0.90057	
" 23...	85.38	5.53	3.31	5.04	0.74	22.1	43° 0	0.90266	

Composition of Jersey Milk for each day analysed.						Butter from the same Milk.			
Date.	Water.	Butter Fat.	Casein.	Sugar.	Ash.	Volatile Acids.	Melting Point.	Specific Grav. at 100° C.	Rations.
Group II.	Pr Ct.	Pr Ct.	Pr Ct.	Pr Ct.	Pr Ct.	Expressed in c. c. one-tenth normal alkali for 5 grms. of fat.	°C.		
Nov. 24...	85.11	4.67	3.84	5.33	0.73	31.4	85° 1	0.90388	<i>Period I.</i> 5 lbs ground oats, 5 lbs ground corn 5 lbs. bran.
" 26...	84.08	5.28	3.93	5.20	0.81	31.5	83° 4	0.90456	
Dec. 8...	86.71	4.75	3.56	5.20	0.68	.....	.....	.....	
" 10...	86.66	4.53	3.84	5.34	0.71	31.7	86° 5	0.90883	<i>Period II.</i> 3 lbs. C. S. meal 4 lbs ground oats, 5 lbs. bran. 11 lbs. ensilage.
" 12...	86.63	3.94	3.66	6.02	0.76	30.6	86° 2	0.90329	
" 23...	86.36	4.74	3.43	5.36	0.73	25.5	87° 5	0.90193	
Jan. 2...	84.31	5.65	3.69	5.43	0.73	25.4	41° 3	0.89796	<i>Period III.</i> 4 lbs. C. S. meal 9 lbs C. S. hulls. 4½ lbs. ensilage.
" 12...	86.17	5.13	3.40	5.60	0.71	30.5	43° 5	0.89751	
" 14...	86.10	4.76	3.47	5.38	0.69	10.2	41° 0	0.89629	
" 16...	85.54	4.30	3.34	5.64	0.68	31.4	43° 0	0.89833	<i>Period IV.</i> raw cotton seed. Cotton seed hulls. <i>Period V.</i> Cooked cotton seed Cotton seed hulls.
" 26...	86.21	4.87	3.13	5.09	0.70	22.0	43° 3	0.89775	
" 28...	86.00	4.86	3.12	5.23	0.72	22.1	43° 3	0.89894	
" 30...	86.39	6.00	3.18	4.73	0.71	31.7	44° 0	0.89803	

Average composition of Jersey Milk during each period.						Butter from Milk			
Period.	Water	Butter Fat.	Caseln.	Sugar.	Ash.	Volatle Acids.	Melting Point.	Specific Grav at 100°C.	Rations.
Group I.									
I.	83.35	5.36	4.00	4.52	0.61	29.8	35° 5	0.90281	5 lbs. each ground oats, ground corn and bran.
II.	84.01	5.47	3.95	5.60	0.81	30.5	36° 1	0.90290	C. S. meal, 3 lbs.; ground oats, 4 lbs.; bran, 5 lbs.; ensilage, 11 lbs.
III.	84.20	5.91	3.60	5.45	0.75	27.5	37° 4	0.90194	C. S. meal, 4 lbs.; cotton seed hulls, 9 lbs.; ensilage, 4½ lbs.
IV.	84.46	6.12	3.49	5.30	0.73	22.1	43° 6	0.90399	Raw cotton seed meal and cotton seed hulls.
V.	85.87	5.45	3.36	5.09	0.73	22.5	43° 7	0.90332	Cooked cotton seed meal and cotton seed hulls.
Group II									
I	84.78	5.30	3.89	5.35	0.77	31.4	34° 2	0.90333	5 lbs. each ground oats, ground corn and bran.
II.	85.87	4.41	3.69	5.52	0.71	31.1	36° 3	0.90132	C. S. meal, 3 lbs.; ground oats, 4 lbs.; bran, 5 lbs.; ensilage.
III	84.79	5.30	3.37	5.64	0.72	26.45	39° 4	0.89995	C. S. meal, 4 lbs.; cotton seed hulls, 9 lbs.; ensilage, 4½ lbs.
IV	85.27	4.69	3.40	5.74	0.69	30.4	42° 5	0.90854	Raw cotton seed meal and cotton seed hulls.
V.	85.87	4.93	3.14	5.63	0.71	21.9	43° 5	0.90857	Raw cotton seed and cotton seed hulls.

The following table, taken from a record carefully kept at the dairy, gives the aggregate amount of milk and butter produced by the first group, consisting of ten cows, for each experimental period of seven days :

	Pounds of milk.	Pounds of butter.	Pounds of milk for one pound of butter.
Period I.....	1,414½	82	17.2 +
“ II.....	1,275	85½	14.9 +
“ III.....	975	91	10.7 +
“ IV.....	896	75	11.9
“ V.....	716	58	12.3 +

As will be observed there is a marked falling off in the quantity of milk and a corresponding increase in the amount of butter produced during the first three periods, as the cattle were getting more under the influence of cotton seed meal.

During the remaining periods the quantities of both milk and butter diminish, the ration being confined to cotton seed and cotton seed meal, without reference to having it well balanced as a milk ration.

The general effects of these valuable feed stuffs, when used in carefully prepared rations, will hereafter be investigated; at present we are concerned only, as previously stated, with their effects on the volatile acids, melting point and specific gravity of the butter fat produced under their influence. For these effects attention is called to the above tabular statements from which the following conclusion is drawn :

Feeding on cotton seed and cotton seed meal increases, in a marked degree the melting point of butter, the increase reaching in these experiments eight or nine degrees, and diminishes to a corresponding extent the volatile acids, while the specific gravity remains virtually the same.

The richness of cotton seed meal in albuminoids renders it of prime importance to mix it with one or more feed stuffs poor in this nitrogenous compound, such as ensilage, hay, or cotton seed hulls.

It may be stated in this connection that no change was observable in the color of the butter from feeding cotton seed and cotton seed meal. The samples, still in the laboratory, are all of a beautiful golden yellow.

It is proper to state that the analytical work in the above tables was done by Dr. J. T. Anderson, first assistant in the chemical laboratory.

AUBURN, ALA., March 27, 1891.

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## “SOME NOTES ON ELECTROLYTIC QUANTITATIVE SEPARATION OF METALS.”

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BY T. O'CONNOR SLOANE, PH. D.

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It may seem somewhat presumptuous after Classen's classic work in electrolytic analysis, to offer any suggestions as to the conducting of this class of quantitative determinations. But there is one point in the work which it may safely be said has been to a certain extent neglected. This point is the influence of electromotive force, or of difference of potential upon the separations.

In Classen's work upon the subject the voltage of the circuit is duly considered, and an elaborate rheostat for regulating the voltage within somewhat crude limits ( $\frac{1}{2}$  volt) is described. This is in one of the introductory chapters. The rheostat is for use with a 600 watt dynamo. But the author also mentions batteries and describes his method of conducting determinations with these sources of electromotive force. The current strength is then the standard, and it is determined by the volume of oxyhydrogen gas, which the current can liberate in a definite time. In other words, the amperage of the current alone receives direct attention. By using the same sized electrodes, the author states, the conditions are kept sensibly the same. Here we have an indirect recognition of the influence of electromotive force. But the attempted

maintenance of the most uniform conditions is a poor reliance. The conditions will inevitably vary and the temperature of the room and gradual change of the nature of the solution operated on will cause variations in resistance that will affect the difference of potential. To show how little regard is paid to voltage, we are directed in iron determinations to use two and sometimes three Bunsen cells. Any change in the number of cells in series would cause great variations in the voltage, in the case cited about 50%. If the cells were kept in parallel and any resistance, such as that of a voltameter, were in series with the decomposing apparatus, a great variation in voltage would even then ensue by changes in the number of cells.

The object of these notes is to plead for a greater recognition of the influence of difference of electric potential in analytical work. The facts of the case are these : For the decomposition of every solution a definite and absolutely fixed voltage is required. The strength of current affects only the condition of the deposit. Thus a current of any number of amperes might be passed through acidulated water without decomposing it until the voltage passed a fixed point when decomposition would at once begin. A single gravity cell, large or small (sulphate of copper-zinc-copper couple) cannot decompose water because its voltage is too low. The minutest bichromate cell will at once begin to decompose it because its voltage is high enough.

Again, the amperage of the current should not be broadly stated without reference to absolutely fixed conditions of electrodes. The proper way would be to state it as referred to unit area of cathode and anode. Probably the cathode reference would be all that is needed. As ordinarily put the cathode is supposed to be a platinum dish of more or less definite size, filled with a variable depth of fluid, and the electrolytic gas set free in one or more minutes is given. All this tells nothing.

It would seem obvious that, a definite and absolutely fixed difference of potential being required for the decomposition of each compound, the voltage could be made the basis for analytical work. It would be possible to effect successive separation of metals from the same solution by modifying the voltage, starting,



of course, with the lowest. How far the precipitation of mixed metals, so called alloys, would interfere with such attempts is not definitely recorded. It amounts to nothing to state, as is done, that a weaker current than is required for iron or some other metals, will precipitate copper. The strength of the current has nothing to do with it. It is the difference of potential that affects the result. The varying of such difference corresponding in a general way with the strength of the current, as the operations were conducted, has doubtless occasioned the confusion.

In stating the results of or giving directions for conducting electrolytic separations, two factors should always be stated. One is the difference of potential, the other the amperage per unit area of cathode. Then something definite would be known. It seems probably that by working on these lines, some exceedingly interesting results in the way of double decompositions as well as of separations, might be obtained.

Should any such result be obtained as the determining of a series of potential differences available for separations of metals from single solutions it would be highly interesting. The heat of combination of a vast number of compounds has been obtained and is readily reduced to volts, but such reduction is theoretical and does not accurately hold for all cases. The principal trouble would lie in the regulation of the voltage. But at the least there seems ground for research in the direction here suggested.

361 BROADWAY, New York.

## SOME ANALYSES OF CARBON MINERALS.

BY CHARLES E. MUNSELL, PH. D.

The following analyses of fourteen specimens of Carbon Minerals, from the collection illustrating Economic Geology at the School of Mines, Columbia College, were made according to the methods described in Cairn's Quantitative Analysis, and have not previously been published.

The specimens were nearly all collected by Prof. J. S. Newberry, whose paper on The Origin and Relations of the Carbon Minerals (Annals of the New York Academy of Sciences, Vol. II., No. 9, 1882), describes the formation of these minerals.

	Water.	Carbon	Hydrogen	Sulphur	Nitrogen	Oxygen.	Ash
<i>Peats.</i>							
Ravenna, Ohio. Surface...	7.95	57.84	7.10	.30	.84	21.12	4.95
" " Bottom ..	12.60	41.81	6.95	6.35	2.34	16.48	13.65
<i>Lignites.</i>							
Kannarruh, Utah Cretaceous .....	7.45	53.95	8.30	.90	.98	23.57	4.85
Cedar City, " .....	2.39	59.55	8.68	1.92	.94	25.69	3.29
Canon City, Colorado .....	5.65	56.95	4.65	1.19	.28	27.66	3.62
Morrison, " .....	8.30	64.05	4.90	.51	.70	17.24	4.50
Fort Berthold, Dakota. ....	8.00	57.20	5.23	1.68	.70	25.52	1.48
Carbon Station, Wyoming ....	7.35	63.65	4.60	.76	1.40	19.41	2.80
Point of Rocks, " .....	5.35	70.50	4.50	.98	1.12	12.55	5.30
<i>Coking Coal</i>							
Crested Butte, Colorado. ....	1.00	74.29	7.49	.61	1.40	9.17	6.04
<i>Anthracites.</i>							
Queen Charlotte's Island, British Columbia.	1.90	75.95	6.03	.93	1.40	6.81	7.96
Crested Butte, Colorado .....	.72	82.50	5.15	.85	1.12	4.55	5.21
<i>Suberite.</i>							
Castle Valley, Utah.....	.67	71.30	7.96	.70	.28	18.05	1.04
<i>Shale</i>							
Green River, Wyoming .....	2.40	45.35	6.41	1.29	.84	2.71	50.02

## LABORATORY NOTES.

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BY DR. L. H. FRIEDBURG.

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### I.—ON ACID CALCIUM TARTRATE.

The best way for the purification of mother liquors of the tartaric acid manufacture is to transform the acid, after removal of most of the free sulphuric acid, into calcium acid tartrate.<sup>1</sup> It has appeared commendable to me to use the solution of calcium acid tartrate, obtained in this way, for the *manufacture* of the salt contained in it, which could then advantageously be used alone or mixed with cream of tartar for baking powders. Manufacturers would save labor and fuel in so doing.

### II.—ON ALKYL IODIDES.

The attempt was made to prepare methyl iodide in a way different from the one in use which consists in treating iodine and red phosphorus with methyl alcohol. The methods applied were the following :

(A). A solution of iodine in methyl alcohol was treated with hydrogen sulphide until the deep brown color of the liquid has entirely disappeared. The presence of methyl iodide was proved by fractional distillation. Sulphur containing products of bad odor were obtained at the same time and the conditions for working these have yet to be found, before the method can be applied.

(B). A solution of iodine in methyl alcohol was treated with sulphur dioxide. Here also methyl iodide was formed in small quantity. The main product consisted of different ethers.

NEW YORK, April 3, 1891.

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<sup>1</sup> *Journ. Am. Chem. Soc.*; 4, 295.

## Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

*Patents issued March 31, 1891.*

**449,104.**—Process of coloring and finishing fabrics. Victor G. Bloede, Baltimore, Md.

The fibre is impregnated with starch or a mixture of starch and coloring matter and then treating the impregnated fibre with a solution of caustic lime or other equivalent compound which has the power of rendering the starch insoluble.

**449,152.**—Artificial stone. Louis Enricht, New York, N. Y.

Prepared from magnesium oxide, calcium oxide, magnesium chloride, sodium silicate, and water.

**449,214.**—Manufacture of artificial stone. Louis Enricht, New York, N. Y.  
A magnesia cement similar to the above.

**449,271.**—Filter for syrups and juices in sugar works. Karl Proks, Prague, Austria-Hungary.

**449,292.**—Ore concentrator. Frank B. Morse, Murphy's, Cal.

**449,339.**—Shoe blacking. George P. Tipton, Hot Springs, Ark.

Arkansas graphite (graphitic shale) is incorporated with the oils and acids of an ordinary shoe blacking.

**449,356.**—Manufacturing chains by electric welding process. Elihu Thomson, Lynn, Mass.

**449,437.**—Tanner's oil. William B. Davis, Newport, N. Y.

An oil mixture consisting of stearine, tallow, raw linseed oil, and oil of citronella.

**449,454.**—Process for degumming and preparing. Walter R. Wade, Brooklyn, N. Y.

Fibre is boiled in an alkaline solution of potash or soda containing saponine.

**449,455.**—Ditto.

The fiber is boiled in an alkaline solution containing quillain bark, or a decoction or extract thereof.

**449,508.**—Process of brewing malt liquors. Basil W. Valentine, Birmingham, Eng.

The unhopped wort, after it has left the mash-tun, is heated to a temperature of about 180° Fahrenheit to coagulate certain nitrogenous substances, and then quickly cooling the wort to a temperature of 150° F., after which the wort is sprayed and filtered through the grain.

**449,510.**—Process of manufacturing cement. George Williams, Winnipeg, Canada.

Carbonate of lime and silicate of soda are treated by steam under pressure and to the resulting compound alumina and silex and a thin paste of chloride of calcium, unslaked lime and warm water are added, the mass molded into convenient forms, then burned to a white heat, after which the mass is ground to a fine condition.

**449,520.**—Benzo-rhodamine. Maurice Ceresole, Neuville, France.

A red dye stuff. Soluble in cold water, more soluble in hot water. Readily soluble in water containing a little hydrochloric acid, readily soluble in alcohol, the red solution showing the striking yellowish-orange fluorescence, insoluble in ether and benzine, soluble in conc. sulphuric acid with orange-yellow color, and in hydrochloric acid giving a scarlet red solution.

**449,530.**—Bengal light compound. Charles Gerhard, Jersey City, N. J.

A compound for Bengal lights consisting of copal, ether, alcohol, strontium, nitrate and potassium chlorate with or without shellac or varnish.

**449,547.**—Composition for use in the manufacture of steel. James Mackintire, Sheffield, England.

A compound consisting of calcium carbonate and phosphate, black oxide of manganese, tannic acid or tannin, vegetable root, animal charcoal or bone black and tar.

**449,551.**—Dihydroxynaphthalene. Eugene Mentha, Ludwigshafen-on-the-Rhine, Germany.

Dihydroxynaphthalene melts at 160°–161° C., is slightly soluble in cold water, readily soluble in hot water, alcohol, ether, fusel oil, slightly soluble in benzine and petroleum ether, and yields an intensely blue coloration with ferric chloride solution.

**449,552.**—Settling and amalgamating pan for machinery for extracting gold and other precious metals. William A. Merralls, Kansas City, Mo.

**449,586.**—Art of producing ground wood pulp. Edward F. Millard, Jackson, Mich.

**449,603.**—Apparatus for making extracts. Stephen C. Thrall, Elk Rapids, Mich.

**449,610.**—Magnetic separator. Richard R. Moffatt, New York.

**449,619.**—Artificial stone or cement. L. Enricht, New York, N. Y.

A magnesia cement.

**449,629.**—Black dye. Jakob Schmid, Basle, Switzerland.

A dark brown powder derived from monoalkylized derivatives of beta-naphthylamine and a diazo compound of the formula



which is easily soluble in water, difficultly soluble in alcohol, insoluble in benzine. Its aqueous solution is not changed by the addition of caustic alkalies, but is precipitated by addition of mineral acids.

*April 7th, 1891.*

**449,675.**—Illuminated embossed paper and process of producing the same. Philipp Hake, Hoboken, N. J.

**449,687.**—Process of and apparatus for making explosives. Hiram S. Maxim, Crayford, England.

**449,726.**—Process of and apparatus for separating ores magnetically. Clinton M. Ball, Troy, N. Y.

**449,787.** ) Paper building material. Silas H. Hamilton, Philadelphia,  
**449,788.** ) Pa.

**449,741.**—Composition for treating seeds. John Johann, Harrison, Wis.  
To prevent the destruction of seeds by insects. The seeds are treated with a solution containing saltpeter and salt, with or without blue vitriol.

**449,747.**—Apparatus for extracting sugar from saccharine materials. George E. Patrick, Ames, Iowa.

**449,750.**—Art of making ornaments, etc., from hair, and composition for use in the same. Margaret I. Waldron, St. Joseph, Mo.

**449,758.**—Process of collecting the aromatic and volatile substances from coffee. Nicholas L. Le Turcq des Rosiers, Etain, France.

**449,788.**—Process of making metallic composition. Elizabeth J. Rollings, Mobile, Ala.

Anti-friction alloys are made by melting the metallic charge and then combining therewith a powdered mixture of plumbago, alum and charcoal.

**449,794.**—Method of preparing flour. Eli H. Dunn, Elma, Iowa.

**449,808.**—Crucible for the manufacture of steel. George Nimmo, Allegheny, Pa.

**449,809.**—Apparatus for the manufacture of gas. Charles Telher, Paris, France.

**449,818.**—Apparatus for extracting gold or silver from ores. Joseph Cragg, Baltimore, Md.

**449,814.**—Lixiviation process of and apparatus for the extraction of gold or silver. Samuel W. Cragg, Baltimore, Md.

**449,815.**—Process of extracting gold or silver from ores. Joseph Cragg, Baltimore, Md.

**449,836.**—Method of electric welding. Elihu Thomson, Swampscott, Mass.

**449,839.**—Process of preparing pepsin. Joseph L. R. Webber, Detroit, Mich.

Animal's stomachs are macerated in acidulated water and to the resultant solution sulphurous acid is added, after which at a suitably high temperature the solution is precipitated and clarified by the addition of sodium sulphate. The precipitated pepsin is dissolved in dilute hydrochloric acid and the sodium sulphate removed by dialysis and crystallization.

**449,850.**—Coffee roaster. Olof Hammarström, Worcester, Mass.

**449,853.**—Device for drawing steam beer. Constant Harth. Willows, Cal.

**449,874.**—Manufacture of decorative relief material. Louis Enricht, New York, N. Y.

**449,890.**—Apparatus for electroplating small articles. Frederick W. Zingsem, New York, N. Y.

**449,976.**—Apparatus for lixiviating sugar. Carl Steffen, Vienna, Austria-Hungary.

**449,998.**—Process and apparatus for hardening hollow articles of steel. Henri A. Brustlein, Unieux, France.

**450,013.**—Ore concentrator. Walter J. Hammond and John Gordon, Rio de Janeiro, Brazil.

**450,020.**—Dyeing machine. Joseph Hussong, Camden, N. J.

**450,037.**—Black dye. Hermann Reisenberger, Höchst-on-the-Main, Germany.

A quinoline compound derived from amido-purpurine, which is a black basic dye or paste, soluble in soda lye with violet red color subliming on heating in small green needles, and, when heated quickly in a tube with twenty parts of zinc dust, converted into the anthraquinoline described by Graebe.

**450,052.**—Apparatus for burning gas tar or other liquid fuel. William Bliss and Enoch Bradbury, etc., Birmingham, Eng.

**450,063.**—Ore concentrating machinery. Calvin M. Fitch, Chicago, Ill.

**450,099.**—Method of producing light by incandescence. Otto B. Fahnehjelm, Stockholm, Sweden.

**450,103.**—Electrolytic apparatus. Ernest A. Le Suem, Ottawa, Canada.

**450,104.**—Electrolytic cell. Ernest A. Le Suem, Ottawa, Canada.

**450,119.**—Process of manufacturing imitation horse hair from palmetto. Constantine B. Warrand, Bluffton, S. C.

**450,120.**—Process of extracting palmetto fiber. Constantine B. Warrand, Bluffton, S. C.

**450,121.**—Process of and composition for tanning. Constantine B. Warrand, Bluffton, S. C.

The hides are subjected to a series of baths containing a compound extracted from the leaves of the saw palmetto (*sabal serrulata*).

**450,123.**—Incandescent light. Otto B. Fahnehjelm, Stockholm, Sweden.

**450,522.**—Fumigating compound. Charles F. Morris and Thomas Chenevat, Blencoe, Iowa.

A mixture consisting of sulphur, white sugar, charcoal, wood ashes, salt, and with or without saltpeter.

**450,531.**—Phosphatic fertilizer. Jacob Reese, Philadelphia, Pa.

Consists of muriate of potash and pulverized calcareous phosphatic slag.

**450,534.**—Apparatus for extracting hops. John Schneider, Cleveland, Ohio.

**450,591.**—Apparatus for making dope for explosives. John C. Schraeder, Dover, N. J.

*April 14th, 1891.*

**450,199.**—Ice freezing machine. Charles C. Smith, Brooklyn, N. Y.

**450,201.**—Brick or tile machine. John C. Titus, New Bremen, Ohio.

**450,232.**—Boiler cleaning compound. Edw. J. Hoffman, Sioux City, Iowa.

A compound consisting of gum of japonica, oak bark, borax, calcined magnesia, carbonate of soda and water.

**450,243.**—Process of clarifying liquids. Carl Liesenberg, Halle-on-the-Saale, Germany.

The process consists in adding to the liquid to be clarified a solution containing a phosphate and sulphurous acid.

**450,253.**—Ammoniated phosphate. Jacob Reese, Pittsburg.

**450,254.**—Phosphatic fertilizer. Jacob Reese, Pittsburg.

**450,255.**—Phosphatic fertilizer. Jacob Reese, Pittsburg.

**450,264.**—Varnish. Edmond W. Todd, Newark, N. J.

A solvent consisting of a distillate of fusel oil, benzine and acetic acid.

**450,280.**—Ore concentrator. Louis W. Young, New York, N. Y.

**450,287.** }  
**450,288.** { Art of making plaster casts. Louis Enricht, New York, N. Y.

**450,304.**—Art of making filaments for electric lighting. Silvanus F. Van Choate, Boston, Mass.

**450,391.**—Centrifugal butter extractor. Adolph Wahlin, Stockholm, Sweden.

**450,404.**—Preparing ozone water. Julius C. Ditrich, New York, N. Y. Water containing a phosphite or hypophosphite is charged with ozone.

**450,425.**—Heat annunciator. Adolph Reinemann, New York, N. Y.

**450,437.**—Feed water purifier. Henry Warden, Philadelphia, Pa.

**450,492.**—Continuous automatic machine for the manufacture of starch. John A. Ostenberg, Des Moines, Iowa.

**450,501.**—Method of recovering vaporized solvents. James R. Whiting, New York, N. Y., and William A. Lawrence, Waterville, N. Y.

**450,887.**—Process of obtaining ecgonine. Carl T. Liebermann, Berlin, and Fritz Giesel, Brunswick, Germany.

**450,890.**—Ore crusher. William L. Morris, Cleveland, Ohio.

**450,980.**—Process for removing lime from hides. Wilhelm Dieterle, Feuerbach, Germany.



The lime is neutralized with an "aqueous solution of oxnaphthoic and cresotinic acids."

**450,998.**—Tanning material. Wilhelm Dieterle, Feuerbach, Germany.

A tanning extract or liquor containing cresotinic acid or its soluble salts.

*April 21st, 1891.*

**450,616.**—Method for burning fuel in furnaces. Ellis F. Edgar, Woodbridge, N. J.

**450,666.**—Machine for welding metals. Herbert E. Fowler, New Haven, Conn.

**450,702.**—Process of reproducing oil paintings. Louis Mayer, London, Eng.

**450,750.**—Process of manufacturing hydraulic cement. James B. Speed, Louisville, Ky.

**450,756.**—Ore washer. William S. Hull and James C. Anderson, Sheffield, Ala.

**450,834.**—Method of making plates of secondary batteries. Stanley C. C. Currie, Philadelphia, Pa.

The method "consists in fusing the salt or salts of a metal, casting and attaching the fused mass to and between a woven envelope and a core, forming a matrix in said mass by removing the core, and attaching the mass to a support by casting fused metal into the matrix and reducing the cast salt or salts to the metallic state by eliminating the acid radical."

**450,840.**—Galvanic battery. Charles Willins, Baltimore, Md.

J. F. G.

REGULAR MEETING, May 1st, 1891.

Vice-President Waller in the chair.

The minutes of the April meeting were read, amended and accepted as amended.

Dr. Waller, as one of the committee appointed to investigate the matter relating to local co-operation of scientific bodies, referred to in the communication from Dr. Britton, made an informal report.

The following members were elected :

Dr. C. S. Boynton, 26 Lafayette place, Burlington, Vt.

A. L. Kennedy, Burlington, Vt.

Dr. G. W. Roberts, 137 W. 34 St., N.Y.

E. D. Williams, Short Hills, N.J.

G. W. Riggs, Ph.B., Ridgefield, Conn.

As Associate :

A. O. Ingalls, Murray, Idaho.

The following gentlemen were nominated for membership :

Dr. Walker Bowman, 76 Broad street, New York.

H. J. M. Schroetter, 342 Washington Boulevard, Chicago, Ill.

Edwin Van Dyck, 5 Spencer place, Brooklyn, N.Y.

For Associate Membership :

H. A. Cutting, M.D., Lunenburg, Vt.

Alexander Maitland, 147 Times Building, N.Y.

The following papers were read : "On Lima Oil," by A. Bourgougnon and J. A. Mandel; read by the Secretary.

"On Condensed Milk," by A. Bourgougnon; read by the Secretary.

"On the action of 66° Sulphuric Acid on Hydrochinon and the Value of the Resulting Sulpho Acid as a Developer for Gelatino-Bromide Plates." (Preliminary Notice) by J. H. Stebbins, Jr.; read by the author.

Mr. Stebbins moved that the Auditing Committee be known hereafter as the Finance Committee.

of course, with the lowest. How far the precipitation of mixed metals, so called alloys, would interfere with such attempts is not definitely recorded. It amounts to nothing to state, as is done, that a weaker current than is required for iron or some other metals, will precipitate copper. The strength of the current has nothing to do with it. It is the difference of potential that affects the result. The varying of such difference corresponding in a general way with the strength of the current, as the operations were conducted, has doubtless occasioned the confusion.

In stating the results of or giving directions for conducting electrolytic separations, two factors should always be stated. One is the difference of potential, the other the amperage per unit area of cathode. Then something definite would be known. It seems probably that by working on these lines, some exceedingly interesting results in the way of double decompositions as well as of separations, might be obtained.

Should any such result be obtained as the determining of a series of potential differences available for separations of metals from single solutions it would be highly interesting. The heat of combination of a vast number of compounds has been obtained and is readily reduced to volts, but such reduction is theoretical and does not accurately hold for all cases. The principal trouble would lie in the regulation of the voltage. But at the least there seems ground for research in the direction here suggested.

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# SOME ANALYSES OF CARBON MINERALS.

By CHARLES E. MUNSELL, PH. D.

The following analyses of fourteen specimens of Carbon Minerals, from the collection illustrating Economic Geology at the School of Mines, Columbia College, were made according to the methods described in Cairn's Quantitative Analysis, and have not previously been published.

The specimens were nearly all collected by Prof. J. S. Newberry, whose paper on The Origin and Relations of the Carbon Minerals (Annals of the New York Academy of Sciences, Vol. II., No. 9, 1862), describes the formation of these minerals.

	Water.	Carbon.	Hydrogen	Sulphur	Nitrogen.	Oxygen.	Ash.
<i>Peats.</i>							
Ravenna Mts., Ohio. Surface.....	7.95	57.84	7.10	.20	.84	21.12	4.95
" " Bottom.....	12.60	41.81	5.96	5.26	2.94	16.48	13.66
<i>Lignite.</i>							
Kanab, Utah. Cretaceous.....	7.45	53.95	8.30	.90	.96	23.57	4.85
Cedar City, ".....	2.39	56.55	6.64	1.22	.94	25.89	5.29
Cancora City, Colorado.....	5.85	56.96	4.65	1.19	.86	27.66	5.62
Morrison, ".....	8.30	64.05	4.50	.51	.70	17.24	4.50
Fort Berthold, Dakota.....	6.00	57.20	5.22	1.88	.70	25.52	1.46
Carbon Station, Wyoming.....	7.35	62.65	4.60	.76	1.40	19.41	2.50
Point of Rocks, ".....	5.35	70.50	4.60	.96	1.12	12.95	5.20
<i>Oil.</i>							
Crowded Butte, Colorado.....	1.00	74.29	7.49	.61	1.40	9.17	6.04
<i>Anthracites.</i>							
Queen Charlotte's Island, British Columbia....	1.90	75.95	6.09	.95	1.40	6.81	7.96
Crowded Butte, Colorado.....	.72	84.50	5.15	.65	1.12	4.55	5.27
<i>Schists.</i>							
Castle Valley, Utah.....	.67	71.30	7.96	.70	.28	18.05	1.04
<i>Shale</i>							
Green River, Wyoming.....	2.40	85.33	6.41	1.29	.64	2.79	50.92

## LABORATORY NOTES.

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BY DR. L. H. FRIEDBURG.

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### I.—ON ACID CALCIUM TARTRATE.

The best way for the purification of mother liquors of the tartaric acid manufacture is to transform the acid, after removal of most of the free sulphuric acid, into calcium acid tartrate.<sup>1</sup> It has appeared commendable to me to use the solution of calcium acid tartrate, obtained in this way, for the *manufacture* of the salt contained in it, which could then advantageously be used alone or mixed with cream of tartar for baking powders. Manufacturers would save labor and fuel in so doing.

### II.—ON ALKYL IODIDES.

The attempt was made to prepare methyl iodide in a way different from the one in use which consists in treating iodine and red phosphorus with methyl alcohol. The methods applied were the following :

(A). A solution of iodine in methyl alcohol was treated with hydrogen sulphide until the deep brown color of the liquid has entirely disappeared. The presence of methyl iodide was proved by fractional distillation. Sulphur containing products of bad odor were obtained at the same time and the conditions for working these have yet to be found, before the method can be applied.

(B). A solution of iodine in methyl alcohol was treated with sulphur dioxide. Here also methyl iodide was formed in small quantity. The main product consisted of different ethers.

NEW YORK, April 3, 1891.

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<sup>1</sup> *Journ. Am. Chem. Soc.*; 4, 295.

## Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

*Patents issued March 31, 1891.*

**449,104.**—Process of coloring and finishing fabrics. Victor G. Bloede, Baltimore, Md.

The fibre is impregnated with starch or a mixture of starch and coloring matter and then treating the impregnated fibre with a solution of caustic lime or other equivalent compound which has the power of rendering the starch insoluble.

**449,152.**—Artificial stone. Louis Enricht, New York, N. Y.

Prepared from magnesium oxide, calcium oxide, magnesium chloride, sodium silicate, and water.

**449,214.**—Manufacture of artifical stone. Louis Enricht, New York, N. Y.

A magnesia cement similar to the above.

**449,271.**—Filter for syrups and juices in sugar works. Karl Proks, Prague, Austria-Hungary.

**449,292.**—Ore concentrator. Frank B. Morse, Murphy's, Cal.

**449,339.**—Shoe blacking. George P. Tipton, Hot Springs, Ark.

Arkansas graphite (graphitic shale) is incorporated with the oils and acids of an ordinary shoe blacking.

**449,356.**—Manufacturing chains by electric welding process. Elihu Thomson, Lynn, Mass.

**449,437.**—Tanner's oil. William B. Davis, Newport, N. Y.

An oil mixture consisting of stearine, tallow, raw linseed oil, and oil of citronella.

**449,454.**—Process for degumming and preparing. Walter R. Wade, Brooklyn, N. Y.

Fibre is boiled in an alkaline solution of potash or soda containing saponine.

**449,455.**—Ditto.

The fiber is boiled in an alkaline solution containing quillain bark, or a decoction or extract thereof.

**449,503.**—Process of brewing malt liquors. Basil W. Valentine, Birmingham, Eng.

The unhopped wort, after it has left the mash-tun, is heated to a temperature of about 180° Fahrenheit to coagulate certain nitrogenous substances, and then quickly cooling the wort to a temperature of 150° F., after which the wort is sprayed and filtered through the grain.

**449,510.**—Process of manufacturing cement. George Williams, Winnipeg, Canada.

Carbonate of lime and silicate of soda are treated by steam under pressure and to the resulting compound alumina and silex and a thin paste of chloride of calcium, unslaked lime and warm water are added, the mass molded into convenient forms, then burned to a white heat, after which the mass is ground to a fine condition.

**449,520.**—Benzo-rhodamine. Maurice Ceresole, Neuville, France.

A red dye stuff. Soluble in cold water, more soluble in hot water. Readily soluble in water containing a little hydrochloric acid, readily soluble in alcohol, the red solution showing the striking yellowish-orange fluorescence, insoluble in ether and benzine, soluble in conc. sulphuric acid with orange-yellow color, and in hydrochloric acid giving a scarlet red solution.

**449,530.**—Bengal light compound. Charles Gerhard, Jersey City, N. J.

A compound for Bengal lights consisting of copal, ether, alcohol, strontium, nitrate and potassium chlorate with or without shellac or varnish.

**449,547.**—Composition for use in the manufacture of steel. James Mackintire, Sheffield, England.

A compound consisting of calcium carbonate and phosphate, black oxide of manganese, tannic acid or tannin, vegetable root, animal charcoal or bone black and tar.

**449,551.**—Dihydroxynaphthalene. Eugene Mentha, Ludwigshafen-on-the-Rhine, Germany.

Dihydroxynaphthalene melts at 160°–161° C., is slightly soluble in cold water, readily soluble in hot water, alcohol, ether, fusel oil, slightly soluble in benzine and petroleum ether, and yields an intensely blue coloration with ferric chloride solution.

**449,552.**—Settling and amalgamating pan for machinery for extracting gold and other precious metals. William A. Merralls, Kansas City, Mo.

**449,586.**—Art of producing ground wood pulp. Edward F. Millard, Jackson, Mich.

**449,603.**—Apparatus for making extracts. Stephen C. Thrall, Elk Rapids, Mich.

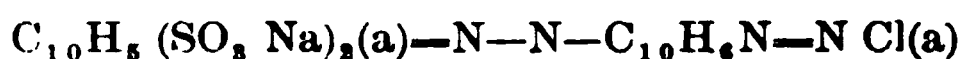
**449,610.**—Magnetic separator. Richard R. Moffatt, New York.

**449,619.**—Artificial stone or cement. L. Enricht, New York, N. Y.

A magnesia cement.

**449,629.**—Black dye. Jakob Schmid, Basle, Switzerland.

A dark brown powder derived from monoalkylized derivatives of beta-naphthylamine and a diazo compound of the formula



which is easily soluble in water, difficultly soluble in alcohol, insoluble in benzine. Its aqueous solution is not changed by the addition of caustic alkalies, but is precipitated by addition of mineral acids.

*April 7th, 1891.*

**449,675.**—Illuminated embossed paper and process of producing the same. Philipp Hake, Hoboken, N. J.

**449,687.**—Process of and apparatus for making explosives. Hiram S. Maxim, Crayford, England.

**449,726.**—Process of and apparatus for separating ores magnetically. Clinton M. Ball, Troy, N. Y.

**449,737.** ) Paper building material. Silas H. Hamilton, Philadelphia,  
**449,738.** ) Pa.

**449,741.**—Composition for treating seeds. John Johann, Harrison, Wis. To prevent the destruction of seeds by insects. The seeds are treated with a solution containing saltpeter and salt, with or without blue vitriol.

**449,747.**—Apparatus for extracting sugar from saccharine materials. George E. Patrick, Ames, Iowa.

**449,750.**—Art of making ornaments, etc., from hair, and composition for use in the same. Margaret I. Waldron, St. Joseph, Mo.

**449,758.**—Process of collecting the aromatic and volatile substances from coffee. Nicholas L. Le Turcq des Rosiers, Etain, France.

**449,788.**—Process of making metallic composition. Elizabeth J. Rollings, Mobile, Ala.

Anti-friction alloys are made by melting the metallic charge and then combining therewith a powdered mixture of plumbago, alum and charcoal.

**449,794.**—Method of preparing flour. Eli H. Dunn, Elma, Iowa.

**449,803.**—Crucible for the manufacture of steel. George Nimmo, Allegheny, Pa.

**449,809.**—Apparatus for the manufacture of gas. Charles Telher, Paris, France.

**449,813.**—Apparatus for extracting gold or silver from ores. Joseph Cragg, Baltimore, Md.

**449,814.**—Lixiviation process of and apparatus for the extraction of gold or silver. Samuel W. Cragg, Baltimore, Md.

**449,815.**—Process of extracting gold or silver from ores. Joseph Cragg, Baltimore, Md.

**449,836.**—Method of electric welding. Elihu Thomson, Swampscott, Mass.

**449,839.**—Process of preparing pepsin. Joseph L. R. Webber, Detroit, Mich.

Animal's stomachs are macerated in acidulated water and to the resultant solution sulphurous acid is added, after which at a suitably high temperature the solution is precipitated and clarified by the addition of sodium sulphate. The precipitated pepsin is dissolved in dilute hydrochloric acid and the sodium sulphate removed by dialysis and crystallization.



**449,850.**—Coffee roaster. Olof Hammarström, Worcester, Mass.

**449,858.**—Device for drawing steam beer. Constant Harth. Willows, Cal.

**449,874.**—Manufacture of decorative relief material. Louis Enricht, New York, N. Y.

**449,890.**—Apparatus for electroplating small articles. Frederick W. Zingsem, New York, N. Y.

**449,976.**—Apparatus for lixiviating sugar. Carl Steffen, Vienna, Austria-Hungary.

**449,998.**—Process and apparatus for hardening hollow articles of steel. Henri A. Brustlein, Unieux, France.

**450,018.**—Ore concentrator. Walter J. Hammond and John Gordon, Rio de Janeiro, Brazil.

**450,020.**—Dyeing machine. Joseph Hussong, Camden, N. J.

**450,037.**—Black dye. Hermann Reisenberger, Höchst-on-the-Main, Germany.

A quinoline compound derived from amido-purpurine, which is a black basic dye or paste, soluble in soda lye with violet red color subliming on heating in small green needles, and, when heated quickly in a tube with twenty parts of zinc dust, converted into the anthraquinoline described by Graebe.

**450,052.**—Apparatus for burning gas tar or other liquid fuel. William Bliss and Enoch Bradbury, etc., Birmingham, Eng.

**450,063.**—Ore concentrating machinery. Calvin M. Fitch, Chicago, Ill.

**450,099.**—Method of producing light by incandescence. Otto B. Fahnehjelm, Stockholm, Sweden.

**450,103.**—Electrolytic apparatus. Ernest A. Le Suem, Ottawa, Canada.

**450,104.**—Electrolytic cell. Ernest A. Le Suem, Ottawa, Canada.

**450,119.**—Process of manufacturing imitation horse hair from palmetto. Constantine B. Warrand, Bluffton, S. C.

**450,120.**—Process of extracting palmetto fiber. Constantine B. Warrand, Bluffton, S. C.

**450,121.**—Process of and composition for tanning. Constantine B. Warrand, Bluffton, S. C.

The hides are subjected to a series of baths containing a compound extracted from the leaves of the saw palmetto (*sabal serrulata*).

**450,123.**—Incandescent light. Otto B. Fahnehjelm, Stockholm, Sweden.

**450,522.**—Fumigating compound. Charles F. Morris and Thomas Chenevat, Blencoe, Iowa.

A mixture consisting of sulphur, white sugar, charcoal, wood ashes, salt, and with or without saltpeter.

**450,531.**—Phosphatic fertilizer. Jacob Reese, Philadelphia, Pa.

Consists of muriate of potash and pulverized calcareous phosphatic slag.

**450,584.**—Apparatus for extracting hops. John Schneider, Cleveland, Ohio.

**450,591.**—Apparatus for making dope for explosives. John C. Schraeder, Dover, N. J.

*April 14th, 1891.*

**450,199.**—Ice freezing machine. Charles C. Smith, Brooklyn, N. Y.

**450,201.**—Brick or tile machine. John C. Titus, New Bremen, Ohio.

**450,282.**—Boiler cleaning compound. Edw. J. Hoffman, Sioux City, Iowa.

A compound consisting of gum of japonica, oak bark, borax, calcined magnesia, carbonate of soda and water.

**450,248.**—Process of clarifying liquids. Carl Liesenberg, Halle-on-the-Saale, Germany.

The process consists in adding to the liquid to be clarified a solution containing a phosphate and sulphurous acid.

**450,253.**—Ammoniated phosphate. Jacob Reese, Pittsburg.

**450,254.**—Phosphatic fertilizer. Jacob Reese, Pittsburg.

**450,255.**—Phosphatic fertilizer. Jacob Reese, Pittsburg.

**450,264.**—Varnish. Edmond W. Todd, Newark, N. J.

A solvent consisting of a distillate of fusel oil, benzine and acetic acid.

**450,280.**—Ore concentrator. Louis W. Young, New York, N. Y.

**450,287.** )  
**450,288.** ) Art of making plaster casts. Louis Enricht, New York, N. Y.

**450,304.**—Art of making filaments for electric lighting. Silvanus F. Van Choate, Boston, Mass.

**450,391.**—Centrifugal butter extractor. Adolph Wahlin, Stockholm, Sweden.

**450,404.**—Preparing ozone water. Julius C. Ditrich, New York, N. Y. Water containing a phosphite or hypophosphite is charged with ozone.

**450,425.**—Heat annunciator. Adolph Reinemann, New York, N. Y.

**450,487.**—Feed water purifier. Henry Warden, Philadelphia, Pa.

**450,492.**—Continuous automatic machine for the manufacture of starch. John A. Ostenberg, Des Moines, Iowa.

**450,501.**—Method of recovering vaporized solvents. James R. Whiting, New York, N. Y., and William A. Lawrence, Waterville, N. Y.

**450,887.**—Process of obtaining ecgonine. Carl T. Liebermann, Berlin, and Fritz Giesel, Brunswick, Germany.

**450,890.**—Ore crusher. William L. Morris, Cleveland, Ohio.

**450,980.**—Process for removing lime from hides. Wilhelm Dieterle, Feuerbach, Germany.

The lime is neutralized with an "aqueous solution of oxnaphthoic and cresotinic acids."

**450,998.**—Tanning material. Wilhelm Dieterle, Feuerbach, Germany.  
A tanning extract or liquor containing cresotinic acid or its soluble salts.

*April 21st, 1891.*

**450,616.**—Method for burning fuel in furnaces. Ellis F. Edgar, Woodbridge, N. J.

**450,666.**—Machine for welding metals. Herbert E. Fowler, New Haven, Conn.

**450,702.**—Process of reproducing oil paintings. Louis Mayer, London, Eng.

**450,750.**—Process of manufacturing hydraulic cement. James B. Speed, Louisville, Ky.

**450,756.**—Ore washer. William S. Hull and James C. Anderson, Sheffield, Ala.

**450,834.**—Method of making plates of secondary batteries. Stanley C. C. Currie, Philadelphia, Pa.

The method "consists in fusing the salt or salts of a metal, casting and attaching the fused mass to and between a woven envelope and a core, forming a matrix in said mass by removing the core, and attaching the mass to a support by casting fused metal into the matrix and reducing the cast salt or salts to the metallic state by eliminating the acid radical."

**450,840.**—Galvanic battery. Charles Willins, Baltimore, Md.

J. F. G.

REGULAR MEETING, May 1st, 1891.

Vice-President Waller in the chair.

The minutes of the April meeting were read, amended and accepted as amended.

Dr. Waller, as one of the committee appointed to investigate the matter relating to local co-operation of scientific bodies, referred to in the communication from Dr. Britton, made an informal report.

The following members were elected :

Dr. C. S. Boynton, 26 Lafayette place, Burlington, Vt.

A. L. Kennedy, Burlington, Vt.

Dr. G. W. Roberts, 137 W. 34 St., N.Y.

E. D. Williams, Short Hills, N.J.

G. W. Riggs, Ph.B., Ridgefield, Conn.

As Associate :

A. O. Ingalls, Murray, Idaho.

The following gentlemen were nominated for membership :

Dr. Walker Bowman, 76 Broad street, New York.

H. J. M. Schroetter, 342 Washington Boulevard, Chicago, Ill.

Edwin Van Dyck, 5 Spencer place, Brooklyn, N.Y.

For Associate Membership :

H. A. Cutting, M.D., Lunenburg, Vt.

Alexander Maitland, 147 Times Building, N.Y.

The following papers were read : "On Lima Oil," by A. Bourgougnon and J. A. Mandel; read by the Secretary.

"On Condensed Milk," by A. Bourgougnon; read by the Secretary.

"On the action of 66° Sulphuric Acid on Hydrochinon and the Value of the Resulting Sulpho Acid as a Developer for Gelatino-Bromide Plates." (Preliminary Notice) by J. H. Stebbins, Jr.; read by the author.

Mr. Stebbins moved that the Auditing Committee be known hereafter as the Finance Committee.

Prof. McMurtrie, offered an amendment providing that the matter be referred to the Board of Directors.

Amendment accepted and carried.

Prof. Barker announced that the council of the American Association for the Advancement of Science had decided to call the Annual Meeting for August 17th and 18th, and that he had a communication from Prof. F. W. Clarke inviting the American Chemical Society to hold its next General Meeting at the same time.

Prof. McMurtrie moved that the communication from Prof. Clarke be referred to the Board of Directors. Carried.

The meeting was then adjourned.

DURAND WOODMAN,  
Recording Secretary.

## OBITUARY.

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JAMES BUCKTON MACKINTOSH.

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This promising member of the American Chemical Society died April 15th, 1891, at the age of thirty-one years.

He was born at Bebington, near Birkenhead, in Cheshire, England, on December 29th, 1859. Owing to the death of his mother while he was very young his early education was obtained under the direction of his father's niece. As the little town where he was born is on the banks of the Mersey, opposite the city of Liverpool, he attended the Institute Schools of that well-known centre and ranked at the head of his classes in mathematics, chemistry and electricity, subjects that, in after life, proved so fruitful of good results in his scientific work. In May, 1873, he passed the local examination of these schools and became "An Associate In Arts of the University of Oxford," and he also passed the examination of the Science and Art Department of the Committee of Council of Education of the English Government, and held a certificate for the same.

In August, 1873, his family came to America and he entered the School of Mines of Columbia College, graduating in 1877 with the dual degree of E.M. and C.E. Remaining in the school he did a large amount of original work on metallurgical subjects which placed him in the front rank of authorities on these matters. His methods of working were marked for their accuracy and delicacy and caused him to be in demand among those manufacturers and others who required special researches upon metallurgical processes. In the year 1886 he went to the Lehigh University to take charge of the chemical laboratory of that institution, and in May, 1888, he became chemist to the Consolidated Gas Company of New York, which position he occupied at the time of his death.

During his later years he was interested in the extraction and preparation of the rare earths of the lanthanum group, and his

excellent work on these metals was cut short by his untimely death.

As a man Mr. Mackintosh was of a most gentle nature, and those who knew him best loved him most. Among scientific workers he was full of enthusiasm and quick to observe practical ideas. As a manipulator of delicate apparatus he had few equals, and this, combined with a clear knowledge of the sciences generally, was the sources of his success. Cut off in his best years we feel that science has lost one of her devoted workers, and his friends a co-laborer whose place in their esteem it is hard to fill.

Loathing pretence, he did with cheerful will  
What others talked of, while their hands were still.

# ON THE ACTION OF 66° SULPHURIC ACID ON HYDROCHINON AND THE VALUE OF THE RESULTING SULPHO ACID AS A DEVELOPER FOR GELATINO-BROMIDE PLATES.

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BY JAMES H. STEBBINS, JR.

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## PRELIMINARY NOTICE.

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Since the introduction of the dry plate in photography many substances have been proposed as developers, but the only practical survivors of the substances thus proposed are pyrogallie acid, ferrous oxalate, hydrochinon, and more recently eikonogen, or the sodium salt of amido- $\beta$ -naphtholmonosulpho acid. Having at one time had occasion to employ hydrochinon as a developer, I was struck with the beautiful qualities of the plates developed by its means, but, although hydrochinon is *per se* a most excellent developer, it has, nevertheless, several drawbacks, among which are its limited solubility in water, and it was this very question of solubility which started me upon the present investigation. It seemed that if hydrochinon could be converted into a mono-sulpho acid, that its solubility would be very materially increased, and if this could be accomplished without in any way affecting its reducing qualities for the haloid salts of silver, a very material improvement would be obtained.

Finding only very meagre information in the literature upon this subject the following experiments were made.

### EXPERIMENT 1.

20 grams of 66° sulphuric acid were mixed with 10 grams of hydrochinon, and then heated under constant stirring upon the steam bath, until the hydrochinon was all dissolved. The stirring was kept up for a few minutes longer, when suddenly the whole contents of the beaker solidified to a cake of small straw colored needles.



The cake was broken up and dissolved in cold water, in which it is very soluble, then converted into its lime salt by neutralizing the acid solution with calcium carbonate. The precipitate of calcium sulphate was filtered off and the filtrate of the lime salt placed upon the steam bath for concentration. After a short exposure to the air the solution began to darken, showing that oxidation was taking place. Concentration by this means had therefore to be abandoned. The solution was then placed under the air pump over sulphuric acid, hoping that by this means it may be concentrated without spoiling, but even in this case oxidation kept slowly taking place. It was therefore decided to treat the mixture with an excess of sodium sulphite and then concentrate in vacuo over sulphuric acid. On adding the sodium sulphite calcium sulphate was precipitated carrying considerable of the coloring matter with it. The precipitate was filtered off, and the filtrate containing the sulpho acid of hydrochinon was placed under the bell jar of the air pump over sulphuric acid, to concentrate, but owing to an accident, the contents of the beaker were spilled, and therefore the experiment had to be repeated.

#### EXPERIMENT 2.

10 grams of hydrochinon were treated as before with 20 grams 66° sulphuric acid. After the reaction the mixture was dissolved in water, heated upon the water bath, and neutralized with barium carbonate.

The barium sulphate was filtered off, and the filtrate containing the barium salt of the sulpho-acid was concentrated in vacuo over sulphuric acid. The barium salt thus obtained crystallized much more readily than the calcium salt and the solution of the same in water does not appear to be as readily oxidizable as the former when exposed to the air. It crystallizes from its aqueous solution in white, warty concretions of star-grouped crystals (needles).

A sample of the above barium salt obtained by rapidly boiling down a portion of its aqueous solution to dryness and then further drying over sulphuric acid gave the following results :

#### *Water of Crystallization.*

0.2810 grm. substance lost 0.0081 grm.  $H_2O$   
equivalent to water 2.88 per cent., or 1 mol. water of crystallization.

*Ba. Estimation.*

0.2810 grm. sub. gave 0.116 grm. Ba SO<sub>4</sub>

Equivalent to Ba.....24.26 per cent.

Equivalent to Ba. in anhydrous salt.....24.98 “

On now attempting to calculate the molecular weight of the barium salt from the amount of barium sulphate formed, we get the following :

0.2729 anhydrous salt gave 0.116 gram. Ba.SO<sub>4</sub>.

.116: 233 (BaSO<sub>4</sub>) :: 0.2729 : x ; x=548.1

The least molecular weight of the salt, carrying one atom of barium, is therefore 548.1.

One atom of barium might belong, however, to a substance containing either one or two sulpho-groups ; but, the theoretical molecular weight of barium hydrochinon disulphonate is 406, whereas the theory for barium hydrochinon monosulphonate is

515, (calculated from the formulæ  $\left( \text{p.C}_6\text{H}_3 \begin{array}{c} \text{OH} \\ \text{---} \text{SO}_3 \\ \text{OH} \end{array} \right)_2 \text{Ba},$ ) and

consequently the former is excluded. Therefore the substance analysed is beyond much doubt the barium salt of a hydrochinon mono-sulpho acid.

On calculating the molecular weight from the salt containing water of crystallization we get :

0.116 : 233 :: 0.281 : x ; x=564.

The theoretical molecular weight of the hydrated salt, or rather salt containing water of crystallization, is 533.

The theoretical amount of barium called for in the anhydrous salt is 26.6 per cent.

The theoretical amount of barium in the hydrated salt is 25.7 per cent.

The amount of water of crystallization found is 2.88 per cent. ; therefore,

$2.88 \div 18 :: 0.16 \text{ mol. H}_2\text{O}.$

That is to say, that 100 parts of barium salt contain 0.16 mol. H<sub>2</sub>O of crystallization ; therefore 548 parts of barium salt will

# 158 ACTION OF 66° SULPHURIC ACID ON HYDROCHINON, ETC.

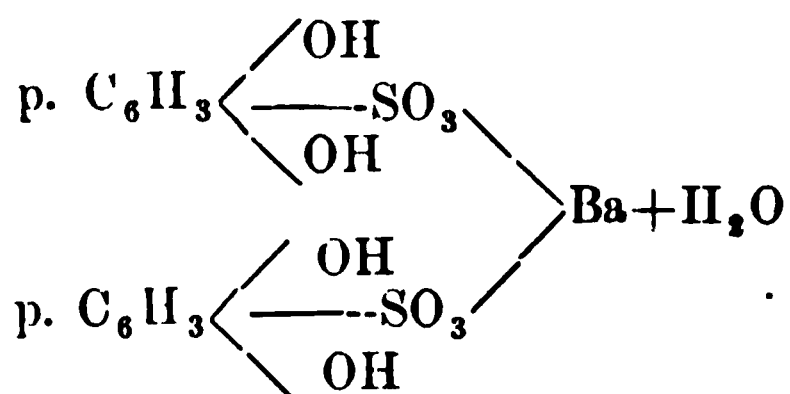
contain  $100 : 0.16 = 548 : 4 ; 4 = 0.87$  mol.  $H_2O$ , or in round numbers 1 mol.  $H_2O$ . We have therefore found :

Barium .....	24.26 per cent.
Water of crystallization .....	2.88     “
Molecular weight .....	564

Whereas theory calls for

Barium .....	25.7 per cent.
Water .....	3.40
Mol. weight .....	533

The formula of the barium salt is therefore, without much doubt :

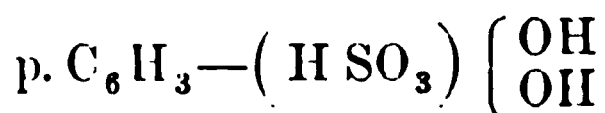


The barium salt is readily soluble in cold water and dilute alcohol and insoluble in strong alcohol. It crystallizes from dilute alcohol in white, six-sided prisms. On adding ferric chloride to its aqueous solution, a momentary deep blue coloration is obtained, which, almost immediately, changes into a dirty yellow color.

## POTASSIUM SALT.

This salt was obtained from the barium salt, by decomposing the latter with the theoretical amount of potassium carbonate. On rapidly concentrating the aqueous solution of the same, out of contact with the air as much as possible, it is obtained in the shape of little, yellowish white needles. Better results, however, are obtained by adding three or four volumes of alcohol to the concentrated aqueous solution, and then allowing the mixture to evaporate under the bell jar of an air pump. It is readily soluble in water.

## FREE ACID.



The free acid may be obtained from the barium salt by accurately decomposing the latter with dilute sulphuric acid, filtering

off the  $\text{BaSO}_4$ , shaking up the filtrate with ether, and then distilling off the latter and allowing to crystallize. A simpler method, and one that works very well, is to place the cake resulting from the action of  $\text{H}_2\text{SO}_4$  upon the hydrochinon, upon porous tiles, till the greater part of the excess of sulphuric acid has been absorbed. Then press the mass between filter paper until nearly every trace of  $\text{H}_2\text{SO}_4$  has been removed. The mass thus obtained is dissolved in as little alcohol as possible, and set aside to crystallize under the air pump. The free acid is thus obtained in long, well defined brownish, transparent, rhombic prisms (some of the crystals were over 1 cm. long), containing alcohol of crystallization. When exposed over sulphuric acid it effloresces, giving off a part, or all, of its alcohol of crystallization.

0.1155 grm. sub. over  $\text{H}_2\text{SO}_4$  lost. .0087 grm. alcohol = 7.53 per cent. On now heating to  $120^\circ \text{C}$ . the said free acid lost .004 grm. more of alcohol. It will therefore be seen that the larger part of the alcohol of crystallization is lost over  $\text{H}_2\text{SO}_4$ .

The total amount of alcohol lost is therefore  $.0087 + .004 = .0127$  gram. = 10.9 per cent.

This equals 0.43 molecule, or in round numbers one-half molecule alcohol of crystallization.

Theory for  $\text{C}_6\text{H}_3(\text{HSO}_3)(\text{OH})_2$ . One-half  $\text{C}_2\text{H}_6\text{O}$  calls for alcohol 10.7 per cent.

It begins to fuse at  $98^\circ \text{C}$ . and is completely fused at  $104^\circ \text{C}$ . (uncorrected). Dissolves readily in water and alcohol.

#### REDUCING ACTION UPON THE HALOID SALTS OF SILVER.

It was thought that the best way to test this question would be to submit some exposed gelatine dry plates to the action of the hydrochinon mono-sulpho acid. For this purpose a preliminary test was made, using an Eatman lantern slide plate, and a solution of the barium salt of the hydrochinon sulpho acid, made slightly alkaline with sodium carbonate. A positive of very fair quality was thus obtained, the tone of color being reddish brown. It developed up very slowly, however, but it is expected that better results will be obtained when using a developer of definite composition.

In conclusion I would state, that I hope soon to complete experiments upon this subject, and will then submit such further results as I may have obtained.

## ON CONDENSED MILK.

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BY A. BOURGOUNON.

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The object in analyzing condensed milk is to find whether this product is derived from whole or skimmed milk. This knowledge is obtained by reconstituting the original milk, and in so doing one at least of the constituents of milk must be known, otherwise the problem would be indeterminate.

Let  $a, b, c, d, e$ , be respectively the water, fat, albuminoids, milk sugar and ash contained in a milk, these constituents together weighing 100 grms.

If now we add to this milk  $x$  grms. of cane sugar and evaporate the original water  $a$ , a quantity represented by  $ay$  ( $y$  fractional) it is evident that  $b, c, d, e$  have not changed in absolute weights, and that the condensed milk obtained from the 100 grms. of the original milk will weigh now

$$100 + x - ay.$$

Since the analysis gives for the different constituents, per cent., new values  $a', b', c', d', e'$  in the condensed milk, it is evident that

$b$  of fat, on  $100 + x - ay$  total weight of condensed milk, represents on 1 of condensed milk

$$\frac{b}{100 + x - ay}$$

and on 100

$$\frac{100 b}{100 + x - ay} = b'$$

$b'$  being the percentage of fat in condensed milk, and in the

same manner we will have for any other constituent,  $\theta$ , in the original milk

$$\frac{100 \theta}{100+x-ay} = \theta'$$

Making  $100+x-ay=D$ , and since in general  $\theta' = \frac{100 \theta}{100+x-ay}$  we have

$$\theta' = \frac{100 \theta}{D}$$

and

$$\theta = \frac{D \theta'}{100}$$

Consequently

$$b = \frac{D b'}{100}$$

$$c = \frac{D c'}{100}$$

$$d = \frac{D d'}{100}$$

$$e = \frac{D e'}{100}$$

This gives, immediately,  $100 \theta = D \theta'$  and  $D = \frac{100 \theta}{\theta'}$  and the denominator  $D$  can be found at once, as soon as we assume  $\theta$  to be known in the original milk, by assuming, *a priori*, any one of the constituents,  $a, b, c, d, e$ .

If we assume  $d$ , then

$$D = \frac{100 d}{d'}$$

and, knowing  $D$ , we can find readily  $b, c, e$  and  $a$  by difference from 100.

All the constituents of the original milk then are found without any difficulty by the simplest equations.

APPLICATION OF THE PRECEDING FORMULÆ.

Found in condensed milk :

a' Water.....	25.47
b' Fat.....	10.05
c' Albuminoids.....	9.36
d' Milk sugar.....	10.19
e' Ash.....	1.92
x Cane sugar.....	40.01
	<hr/>
	100

Assuming that milk sugar = 4 p. c. in normal milk, we have

$$d = \frac{D d'}{100}, D = \frac{100 d}{d'} = \frac{100 \times 4}{10.19} = 39.25$$

and

$b = \frac{39.25 \times 10.05}{100} = 3.94$	per cent. Fat	in original milk.
$c = \frac{39.25 \times 9.36}{100} = 3.67$	“ Albuminoids	“ “
$d = \frac{39.25 \times 10.19}{100} = 4.00$	“ Milk sugar	“ “
$e = \frac{39.25 \times 1.92}{100} = 0.75$	“ Ash	“ “
	<hr/>	
12.36	“ Solids	“ “
87.64	“ Water	“ “

Assuming respectively for *b* or *c* or *d* or *e* values increasing by 0.1, what will be the composition of the original milk calculated on these different assumptions and using the preceding formulæ.

Composition of an original milk :

a Water.....	86.87
b Fat.....	3.50
c Albuminoids.....	4.92
d Milk sugar.....	4.00
e Ash.....	0.70
	<hr/>
	99.99

to which we add 12.00 of cane sugar.

Water .....	86.87
Fat.....	3.50
Albuminoids.....	4.92
Milk sugar.....	4.00
Ash.....	0.70
Cane sugar .....	12.00
	<hr/>
	111.99

or in per cent. .

Water .....	77.57
Fat .....	3.12
Albuminoids.....	4.39
Milk sugar .....	3.57
Ash.....	0.63
Cane sugar.....	10.72
	<hr/>
	100.00

Further we concentrate to 90 per cent. of the original quantity of water.

Water .....	7.76
Fat .....	3.12
Albuminoids.....	4.39
Milk sugar .....	3.57
Ash .....	0.63
Cane sugar .....	10.72
	<hr/>
	30.19

The composition per cent. of the condensed milk will then be :

a' Water .....	25.70
b' Fat.....	10.35
c' Albuminoids.....	14.54
d' Milk sugar .....	11.83
e' Ash.....	2.08
x Cane sugar.....	35.50
	<hr/>
	100.00



Then we know to a certainty that this condensed milk comes from an original milk of known composition and in assuming for  $b, c, d, e$  the values given we shall, from the values  $a', b', c', etc.$ , of the condensed milk, find the composition of this original milk.

We have  $d=4.00$

$$D = \frac{100 d}{d'} = \frac{100 \times 4}{11.83} = 33.81$$

and

$$b = \frac{33.81 \times 10.35}{100} = 3.50 \text{ per cent. Fat} \quad \text{in original milk.}$$

$$c = \frac{33.81 \times 14.54}{100} = 4.92 \quad \text{“ Albuminoids “ “}$$

$$d = \frac{33.81 \times 11.83}{100} = 4.00 \quad \text{“ Milk sugar “ “}$$

$$e = \frac{33.81 \times 2.08}{100} = 0.70 \quad \text{“ Ash “ “}$$

$$\frac{13.12}{86.88} \quad \text{“ Solids “ “}$$

$$\text{“ Water “ “}$$

As a verification the water  $a$  could be obtained directly.

Since we have

$$100 + x - ay = D$$

$ay = 100 + x - D = 112 - 33.81 = 78.19$ , the weight of water evaporated, then there remains  $a - ay$  water in the original milk on a total weight  $D$  of condensed milk, corresponding in 100 to

$$\frac{100 (a - ay)}{D} = a'$$

whence

$$a = ay + \frac{Da'}{100}$$

or

$$a = 78.19 + \frac{33.81 \times 25.70}{100} = 86.88$$

The following table shows the increase of 0.1 for *b*, *c*, *etc.*, that is, instead of *b*=3.50, *b*=3.60. Instead of *c*=4.92, *c*=5.02, *etc.*

ORIGINAL MILK.	PROCEEDING BY INCREASE OF 0.1 PER CENT. AND ASSUMING			
	d	b	c	e
a=86.87 .....	86.55	86.50	86.59	84.99
b= 3.50 .....	3.586	3.60	3.77	4.00
c= 4.92 .....	5.04	5.06	5.02	5.62
d= 4.00 .....	4.10	4.11	4.08	4.58
e= 0.70 .....	0.716	0.72	0.71	0.80
x=12.00 .....	12.30	12.34	12.24	13.79
D=33.81 .....	34.65	34.78	35.27	38.65

We see that assuming *e*, the ash is out of the question ; its percentage being always small, it is the constituent for which the smallest difference has the greater results.

*c*, *b* and *d* appear to be the constituents of which the variations have the least influence, in fact any of these three assumptions of increase of 0.1 per cent. in *c*, *b* and *d* does not practically affect the composition of the original milk these constituents entering for nearly 4 per cent. each in the milk. Then we are limited in our choice to the one of these constituents of which the variations being the least, the average is the nearest to a constant. If milk sugar is such a constituent, as it appears to be, it is the one to be assumed.

To verify the correctness of the preceding formulæ, let us take again the original milk.

a Water .....	86.87
b Fat .....	3.50
c Albuminoids .....	4.92
d Milk sugar .....	4.00
e Ash .....	0.70
<hr/>	
99.99	

from which, after the addition of cane sugar and the evaporation of water, the following condensed milk has been obtained.

a' Water.....	25.70
b' Fat.....	10.35
c' Albuminoids.....	14.54
d' Milk sugar.....	11.83
e' Ash.....	2.08
x Cane sugar.....	35.50
	<hr/>
	100.00

After the addition of  $x$  of cane sugar to the normal milk and the evaporation of  $ay$  of water, the mixture weighs

$$100 + x - ay = 100 + x - 86.87 y$$

and there is left  $a - ay = a(1 - y)$  water in the condensed milk, and it contains

Water.....	$a(1 - y) = 86.87 (1 - y)$
Fat.....	$b'$
Albuminoids.....	$c'$
Milk sugar.....	$d'$
Ash.....	$e'$
Cane sugar.....	$x$

In the condensed milk weighing  $100 + x - 86.87 y$  we have  
 $a(1 - y)$  water

and in 100

$$\frac{100 a (1 - y)}{100 + x - 86.87 y}$$

and we have then

a' Water.....	$\frac{86.87 - 86.87 y}{100 + x - 86.87 y} = 25.70$
b' Fat.....	$\frac{100 b}{100 + x - 86.87 y} = 10.35$
c' Albuminoids.....	$\frac{100 c}{100 + x - 86.87 y} = 14.54$
d' Milk sugar.....	$\frac{100 d}{100 + x - 86.87 y} = 11.83$
e' Ash.....	$\frac{100 e}{100 + x - 86.87 y} = 2.08$
x Cane sugar.....	$\frac{100 x}{100 + x - 86.87 y} = 35.50$

To find the values of  $x$  and  $y$  we can operate upon any of these equations, since we know the composition of the original milk.

Taking  $d=4$  and  $b=3.50$  we have

$$\begin{aligned} 350 &= 1035 + 10.35 x - 899.10 y \\ 400 &= 1183 + 11.83 x - 1027.67 y \end{aligned}$$

whence

$$y = 0.811 \text{ and } x = 4.26$$

and the common denominator will be

$$104.26 - 70.45 = 33.81$$

as we had found before by a shorter method.

As we have remarked, it is indispensable to know at least one of the constituents of the original milk to be able to calculate its composition from the values obtained from the condensed milk.

If in the milk under consideration we had assumed only that it contains 86.87 per cent. of water it is evident that from the equations

$$\frac{86.87 - 86.87 y}{100 + x - 86.87 y} = 25.70$$

and

$$\frac{100 x}{100 + x - 86.87 y} = 35.50$$

we could obtain the composition of the original milk.

Resolved, these equations give

$$x = 12 \text{ and } y = 0.9$$

and as before 31.81 for factor.

If we do not assume any known quantity in the original milk the equation for water is

$$\frac{100 a (1-y)}{100 + x - ay} = 25.70.$$

and the problem is indeterminate.

## OHIO PETROLEUM.

BY J. A. MANDEL AND A. BOURGOUGNON.

This petroleum, produced at Lima, Ohio, is of a dark green color, very fluid, and marks 48° Baumé at 15° C. (Sp. Gr., 0.791). We did not observe that peculiar objectionable odor which the crude oil pumped from the oil fields of Ohio is said to possess. The refined products, naphtha and burning oil, had the same smell as that of the distillates obtained from Pennsylvania petroleum.

The refining of the naphtha was easily attained with sulphuric acid and washing.

The burning oil purified in the usual manner with sulphuric acid, caustic soda and washing, furnished a burning oil water white, without any fluorescence, better than standard.

The distillation in fifty parts, each part representing two per cent. by volume, gave the following results :

Per Cent.	Specific Gravity.	Per Cent.	Specific Gravity.	Per Cent.	Specific Gravity.	Per Cent.	Specific Gravity.	Per Cent.	Specific Gravity.
2	0.680	22	730	42	782	62	804	82	818
4	683	24	735	44	788	64	808	84	818
6	685	26	740	46	792	66	812	86	810
8	690	28	742	48	800	68	820	88	815
10	694	30	746	50	802	70	825	90	815
12	698	32	760	52	806	72	830	92	} Residuum.
14	700	34	764	54	806	73	830	94	
16	706	36	768	56	806	76	810	96	
18	720	38	772	58	806	78	820	98	
20	728	40	778	60	800	80	820	100	

### RETURNS.

16	per cent.	Naphtha,	70° Baumé.
68	“	Burning oil.	
6	“	Paraffine oil.	
10	“	Residuum.	

The distillation started at 23° C. (we received this sample in the last part of October, 1890), this being due to the large amount of naphtha present, and when 60 per cent. were reached, at a temperature of 310° C., the hydrocarbons remaining in the retort were dissociated then gases escaped, lighter distillates were obtained, and as usual in such cases, the temperature decreased as indicated by the thermometer placed in the retort.

This decrease in the temperature was considerable, from 310° C. the thermometer went down gradually to 200° C. until 75 per cent. of oil were obtained, and from this point the temperature remained constant until the end of the distillation, therefore these hydrocarbons in *statu moriendi* absorbed much heat.

The areometer for liquids lighter than water, or a "*pese esprit*" of Baumé is universally adopted in all dealings with petroleum and its products for the determination of the weight of unity of volume.

One of us has given (*Proc. Am. Chem. Soc., Vol. 1, No. 5, p. 55*), formulæ for the conversion of areometric degrees into corresponding specific gravities for the hydromajor and hydrominor instruments of Baumé.

The calculated table for liquids heavier than water has been integrally reproduced (*Tucker Sugar Analysis, p. 109*).

For the modulus of the areometer for liquids lighter than water, several numbers have been proposed ; Dr. Tucker gives 146 against 144.329 as calculated and recorded in the communication above referred to. To calculate the constant number of an areometer it is necessary to know two specific gravities corresponding to two degrees of the scale, the number 144.329 was obtained by taking the 66th degree corresponding to 0.720 (*loc. cit.*)

Baumé has not given the specific gravities of the salt solutions he employed for the graduation of his instruments, and therefore these solutions are no longer employed.

The earliest specific gravity of the salt solution employed for the graduation of Baumé's hydrominor instrument that we could find is 1.073 (*Chevallier, Art de l'Ingénieur, etc., Paris, 1819*).

Adopting this specific gravity, and keeping the same notation as employed in the paper cited above, we have

$$\frac{V}{v} = \frac{1.073}{1} \text{ and } \frac{v+10}{v} = 1.073$$

whence

$$v = 136.9.$$

Gay-Lussac observed that the 30th degree of the areometer of Cartier corresponded to the 32d degree of Baumé; he also found that the 28th Cartier corresponded to the specific gravity 0.8791, therefore these two instruments can be employed to verify the correctness of their respective graduation.

$$1^{\circ} \text{ Cartier} = \frac{32}{30} 1.066 \text{ Baumé}$$

$$28^{\circ} \text{ C} \times 1.066 = 29.848 \text{ B}$$

$$\frac{144.329}{134.329 + 29.848} = 0.8791$$

and again,

Absolute alcohol at 15° C. has a specific gravity=0.795 and mark 44° Cartier

$$44 \times 1.066 = 46.904 \text{ B.}$$

In the table we read 47° B=0.795 specific gravity, a satisfactory result, since the numbers employed in these calculation have not a common measure.

## Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

Issued May 5th, 1891.

**451,487.**—Process for making Paris-green. John C. Jessup, Digton, Mass.

**451,502.**—Blue dye. Johannes Mohler and Carl A. Mayer, Basle, Switzerland.

A sulpho-acid derived from tannin, aniline and nitroso-dimethylamine having the form of dark crystalline powder insoluble in acidulated water, but slightly soluble in pure cold water, and with difficulty soluble in boiling water, and combined with alkalies it forms salts that are readily soluble in either warm or cold water.

**451,531.**—Process of neutralizing sulpho-chlorinated oils. Adolph Sommer, Berkeley, Cal.

Previous to the addition of chloride of sulphur an oxide or other compound of manganese is incorporated with the oil to be heated.

**451,540 and 451,541.**—Secondary battery. George A. Washburn, Cleveland, Ohio.

**451,592.**—Process of coating metal. Francis J. Clamer, Philadelphia, Pa.

The metallic surfaces are cleansed in suitable cleansing baths, immersed in a bath of muriatic acid, then in a bath of saturated solution of tin, zinc and muriatic acid, and finally coated in a bath composed of lead, sal-ammonia, arsenic, and phosphate of lead.

**451,612.**—Method of utilizing products of combustion. Emil Biedermann and E. W. Harvey, Westminster, Eng.

**451,642.**—Process of purifying suint. Israel Roos, Frankfort-on-the-Main, Germany.

The wool fat is first treated with hot water, then with alkaline solution, the mixture is boiled, allowed to cool and settle, the non-saponifiable matter is separated, then treated with dilute acid, and finally washed with water.

**451,660.**—Process of refining hydro-carbons. Edward D. Kendall, Brooklyn, N. Y.

Mineral hydrocarbon oils containing sulphur are mixed with mercuric chloride in solution, and the absorbed mercuric compound is finally removed by means of a suitable sulphide.



**451,679.**—Apparatus for manufacturing alcohol from sugar cane. Gaston Descamp, Havana, Cuba.

**451,706.**—Yeast cake. James W. Cameron, New York, N. Y.

A yeast cake enclosed in a shell of flour paste and chalk (soapstone).

**453,724.**—Process of purifying petroleum distillates. Thomas J. Gordon, Lima, Ohio.

**451,799.**—Process of ornamenting artificial stone. William Bleiss, Kansas City, Mo.

**451,847.**—Artificial musk. Albert Baur, Gispersleben, Germany.

A trinitrated hydrocarbon derived from toluene or its homologues in solid crystalline form characterized by the odor of natural musk.

*Issued May 12th, 1891.*

**451,926.**—Concentrating apparatus. Ryerson D. Gates, Chicago, Ill.

**451,948.**—Galvanic battery. G. C. McCullough, Richmond, Ind.

**452,030.**—Process of manufacturing sodium and potassium. Hamilton Y. Castner, London, Eng.

**452,062.**—Apparatus for the manufacture of sugar. Louis E. A. Prangey, Paris, France.

**452,063.**—Manufacture of refined sugar. Louis E. A. Prangey, Paris, France.

**452,072.**—Apparatus for bleaching paper pulp. Joseph Jordan, Bridgeport, Pa.

**452,125.**—Apparatus for extracting metals from their ores. Werner von Siemens, Berlin, Germany.

**452,149.**—Device for fermenting beer. Jacob F. Theurer, Milwaukee, Wis.

**452,197.**—Orange yellow dye. Jacob Schmid, Basle, Switzerland.

An orange yellow dye stuff derived from salicylic acid and resorcin, which appears in the form of an orange brown paste, or when dry as an orange brown powder, easily soluble in water and alcohol, and insoluble in benzine.

**452,210.**—Process of dyeing with gallacetophenone. René Bohn, Ludwigshafen-on-the Rhine, Germany.

**452,246.**—Apparatus for the manufacture of hydrogen gas. James W. Tallmadge, Albany, N. Y.

**452,263.**—Process for making white lead. Ellert W. Dahl, New York, N. Y.

**452,273.**—Ammonia absorber. Frederick Kaiser, Knoxville, Tenn.

**452,324.**—Process of dyeing aniline black. Heinrich Thies, Barmen, Germany.

Vegetable fibres, etc., are exposed to the action of aniline oil in the presence of hydrochloric acid, an alkaline salt, and hydrofluoric acid.

*Issued May 19, 1891.*

**452,378.** — Process of making ammonium sulphite. Prosper de Lachomette, Lyons, France.

Dry ammonia and sulphurous gas are conducted in suitable proportions into a saturating tank.

**452,386.** — Process of making lead sulphate. Heaton Pennington, Chicago, Ill.

Lead acetate is first prepared from metallic lead and then treated directly with a suitable quantity of sulphuric acid.

**452,405.** — Apparatus for preparing infusions of coffee. George R. Wilson, Finsbury, Eng.

**452,407.** — Process of making hard potash soap. Johann N. Zeitler, Darmstadt, Germany.

**452,439.** — Production of reclaimed rubber. Rudolph A. Loewenthal, New York, N. Y.

**452,454.** — Process of extracting sugar from molasses. Marie F. E. E. Marondeau, Paris, France.

**452,479.** — Method of manufacturing articles of combined hard rubber and metal. Frank Lambert, Brooklyn, N. Y.

**452,507.** — Apparatus for concentrating solutions. John Patten, New York, N. Y.

**452,512.** — Apparatus for impregnating liquids with gas. Ulrich Bachman, San Francisco, Cal.

**452,535.** — Condenser-coil for ice-making machines. Ehr Gott T. Winkler, Philadelphia, Pa.

**452,536.** — Ice-making and refrigerating machine. Ehr Gott T. Winkler, Philadelphia, Pa.

**452,537.** — Compression pump for ice-making machines. Ehr Gott T. Winkler, Philadelphia, Pa.

**452,538.** — Combined rain-water cut-off and filter. William W. Bays, Knoxville, Tenn.

**452,578.** — Process for refining crude petroleum. Charles C. Mengel, Sr., Bay City, Mich.

**452,676.** — Ore-concentrator. Fred. Manuel and Kenneth M. Reeves, Helena, Mont.

**452,697.** — Process and apparatus for the manufacture of gas. Walter P. Elliott, New York, N. Y.

**452,783.** — Process of manufacturing mineral wool. Charles H. Rockwell, Cleveland, Ohio.

**452,760.** — Composition of matter for insulating purposes. Frederick Salathe, Jersey City, N. J.

A compound of some hydrocarbon product, sulphur and india rubber, gutta-percha, or oxidized linseed oil.

**452,764.**—Hydrocarbon product. Frederick Salathe, Jersey City, N. J.

A solid material of the  $C_{10}H_{16}$  series, having sp. gr. 1.028, tough and of a glossy, jet black color, flexible and somewhat plastic at ordinary temperatures, soluble in naphtha and turpentine, capable of withstanding a temperature of 600° F., and resisting acids and alkalies, excepting concentrated nitric and concentrated sulphuric acids.

*Issued May, 26, 1891.*

**452,794.**—Melting furnace, William W. Keys, Bridgeport, Conn.

**452,800.**—Method of soldering aluminium. Frank J. Page and Harry A. Anderson, Waterbury, Conn.

The surfaces to be joined are fluxed with silver chloride and solder is then introduced upon the surfaces.

**452,821.**—Manufacturing of phosphorus. Herbert H. Wing, Buffalo, N. Y.

A mixture of a phosphate and a silicate is calcined in a reducing flame, whereby the phosphoric anhydride is expelled and reduced. The fumes are conducted through a depositing chamber, which is kept at a temperature of about 500° F., in which the red phosphorus is deposited. The remaining fumes are passed through water chambers wherein the yellow phosphorus is condensed.

**452,869.**—Artificial ivory. George W. Tooker, New York, N. Y.

Made from albumen, bone-ash powder talc, and fibrous material.

**452,967.**—Process of refining linseed oil. Thomas H. Grey, Bermondsey, Eng.

The oil is first treated with a solution of caustic alkali of a strength of about 30°. Common salt is finally added, the whole thoroughly mixed, allowed to settle and the clear oil decanted.

**453,005.**—Apparatus for producing anhydrous ammonia. Daniel L. Holden, New York, N. Y.

**453,035.**—Guaiacol ether. Joseph Bougartz, Aachin, Höchst-on-the-Main, Germany.

**453,105.**—Water purifier. Eugene Britney, Indianapolis, Ind.

**453,115.**—Mineral wool. Charles H. Hubbell, St. Louis, Mo.

**453,187.**—Process of making basic persulphate of iron. Joseph Van Ruymbeke, Chicago, Ill.

Sulphuric acid and oxide of iron are mixed and heated to a temperature of 380 to 500° F., until the water has been expelled and a persulphate of requisite basicity produced.

**453,140.**—Apparatus for the manufacture of carbon black. Edwin Binney, New York, N. Y.

J. F. G.

REGULAR MEETING, June 5th, 1891.

Vice-President Breneman in the chair.

The minutes of the Board of Directors, held May 19th, containing recommendations to the Society in regard to holding a Summer general meeting and sending a Committee of Conference to Washington, were read and approved.

The following gentlemen were then elected.

As members :

Walker Bowman, Ph. D., 76 Broad street, New York.

Edwin Van Dyck, 5 Spencer place, Brooklyn, N. Y.

H. J. M. Schroetter, 342 Washington Boulevard, Chicago, Ill.

As Associates :

H. A. Cutting, M. D., Lunenburg, Vt.

Mr. Alexander Maitland, 147 Times Building, New York.

Geo. H. Baest, Ph. C., West Lafayette, Indiana, was nominated for membership.

The following papers were read :

Note on the Action of Water on Lead Pipe, by Dr. Elwyn Waller.

On Three Samples of Crude Petroleum, by Dr. Durand Woodman.

An Apparatus for Heating Sealed Tubes, by Dr. Durand Woodman.

The question of holding a general meeting in August was then considered.

Mr. Stebbins moved that the Secretary send out notices asking the members to state whether they were in favor of a general meeting at Washington, in August, and if not, to state their preference as to time and place.

Mr. Geisler moved as an amendment that at least two other places be mentioned in such circular for members to select from.

Amendment accepted, and Mr. Stebbins' motion seconded and carried as amended.

Prof. Hale moved that all other matters pertaining to holding a Summer general meeting be referred to the Board of Directors. Seconded and carried unanimously.

The meeting was then adjourned.

DURAND WOODMAN,  
Recording Secretary.

NOTE ON THE ACTION OF WATERS UPON LEAD PIPE.

By E. WALLER, Ph.D.

About nine months ago, a couple of samples of water were sent to me from the mountain region of Kentucky. They were stated to be from creeks in that region, and the intention was to utilize one or both of them for domestic purposes. The results of the analysis were as follows in parts per 100,000 :

	I.	II.
Appearance: Faintly turbid, brownish.		
Odor when heated to 100° F.....	none.	none.
Chlorine in chlorides.....	0.0311	0.0560
Phosphates and nitrates.....	none.	none.
Nitrogen in nitrates.....	0.0165	0.0247
Free ammonia.....	0.0004	trace.
Albuminoid ammonia.....	0.0046	0.0016
Hardness temporary.....	0.950	0.750
“ permanent.....	1.40	1.300
Organic and volatile (loss on ignition).....	1.300	1.400
Total solids.....	3.400	2.900

	I.	II.
	Salts.	Salts.
NaCl .....	0.051	0.092
K <sub>2</sub> SO <sub>4</sub> .....	0.284	0.263
Na <sub>2</sub> SO <sub>4</sub> .....	0.157	0.093
Na <sub>2</sub> CO <sub>3</sub> .....	0.032	0.017
Ca CO <sub>3</sub> .....	0.556	0.404
Mg CO <sub>3</sub> .....	0.501	0.346
Fe <sub>2</sub> O <sub>3</sub> and Al <sub>2</sub> O <sub>3</sub> .....	0.107	0.180
Si O <sub>2</sub> .....	0.912	0.957
Organic (by difference).....	0.800	0.548
Total .....	3.400	2.900

The results, as may be perceived, are such as to allay any suspicions of organic pollution, indeed the accounts given me of the surroundings were such as would lead to a conclusion as to their safety in that regard, irrespective of the analysis.

Since, however, the water was to be used in several houses, in some or all of which leaden pipes might be used as service pipes, I made, as I frequently do, a test as to the action of these waters upon lead. Pieces of ordinary lead pipe which had been used for service pipe were filed and scraped perfectly bright and clean, and then placed in stoppered bottles, each having a capacity of about 300 c. c. The bottles were then filled with the waters and labelled.

As a comparison test, a piece of the lead pipe, cleaned in the same manner, was placed in a bottle, and Croton water run in in the same way. All three bottles were thus stoppered and set aside. After standing for about 20 hours, all three bottles showed a slight separation of white granular material which was proved by tests to contain lead. The bright surface of the pieces of lead pipe, had also become dull, indicating some action. The waters, however, on filtering showed no decided reaction for lead in solution. The action of the Croton water was appreciably less than either of the others. The water and sediment was poured off, and after two or three rinsings with fresh lots of the respective samples to remove all perceptible sediment, fresh portions of the waters were run in upon the lead, and they were again put by, as before, at the ordinary temperature of the laboratory, for 24 hours. At the end of that time practically no separation of lead scales had occurred with the Croton water, a little had shown itself with No. I. and much more with No. II. The operation of rinsing off and refilling with water was repeated and at the end of the next 24 hours, the Croton water showed no sediment, No. I. showed hardly any, while No. II. showed about the same amount as before. They were then allowed to stand, without further changing of the water, and they have been allowed to stand thus ever since.

The results I have brought to show you as they may be interesting. The lead in the Croton water has become blacker with time, and had developed in one or two spots, some white crusts which seem to be moderately hard, and firmly adherent. Practically no sediment has formed. In the No. I. water the lead has a more

whitish appearance, and some particles of the lead compound have become detached forming some sediment. But, in the case of No. II. the scales, of white lead compound appear to have become detached almost as fast as formed, and the action seems to be going on indefinitely, for, as may be seen, it nearly conceals the piece of lead, being nearly half an inch in depth, and has when shaken the pearly crystalline appearance such as are often obtained by pouring solutions of bismuth salts into a large bulk of water.

Whatever may be the impurities in the lead, the pieces must be very nearly of the same character in all, for they were cut from the same piece of pipe.

The action appeared to be quite rapid at first, and has become slower as time has gone on, but for a long time the increase in the amount of separated lead salt was quite perceptible from week to week, and even now can be perceived by inspection at longer intervals.

The action corresponds almost exactly to the description given by Professor Frederick Penny of the action of Loch Katrine water upon lead *in open vessels*. Water No. I. in the closed bottle acts in very much the same manner as the Loch Katrine water in closed vessels, described by Professor Penny.\* The analysis of the Loch Katrine water given in his report, shows about the same proportion of solids, though the salts are different in their respective amounts. His figures are given in grains per gallon, presumably the imperial gallon of 70,000 grains. On that assumption, I have calculated the proportions per 100,000, for comparison with the figures already given.

LOCH KATRINE WATER. (Analysis by Prof. Penny).

	"Grains per gallon."	Parts per 100,000.
Organic matter.....	0.900	1.285
Ca SO <sub>4</sub> .....	0.381	0.544
Ca Cl <sub>2</sub> .....	0.144	0.206
Alkaline chlorides.....	0.433	0.619
Mg CO <sub>3</sub> .....	0.216	0.309
Si O <sub>2</sub> and phosphates.....	0.170	0.243
Fe <sub>2</sub> O <sub>3</sub> .....	traces	traces
	<hr/>	<hr/>
Total	2.244	3.206

Hardness, 0.8°

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\* Reports and opinions on the use of lead pipe for service pipe. J. P. Kirkwood, New York, 1859. Page 212.

# ON THREE SAMPLES OF CRUDE PETROLEUM.

BY DURAND WOODMAN, Ph. D.

1st. A sample of crude oil from the Lima, O., field. Sp. Gr. at 60° F. (15.5° C) = 0.835 (39° B). Color, brown; slight fluorescence. Odor, peculiar and disagreeable.

2d. A sample of crude oil from California. Sp. Gr. at 60° F., 0.835 (=39.0° B). Color, dark brown, opaque; no appearance of fluorescence except on dilution. Odor, peculiar; quite different from the Lima oil, and not as disagreeable. The odor of some of the distillates from these oils was much intensified.\* Some of the California distillates had an agreeable odor.

300 c.c. of these oils were taken for distillation. The receiver was changed at every 15 c.c. = 5%. Thermometer bulb opposite exit of retort. Temperature taken at moment of removing the receiver.

Each distillation occupied four hours. The results are tabulated in the accompanying table.

TABLE OF DISTILLATES.

	t F.		Sp. Gr. at 60° F. (15.5° C)		°B.		Per Cent.
	Lima.	Cal.	Lima.	Cal.	Lima.	Cal.	
1	160°	160°	0.704	0.706	70°.5	70°.0	5
2	200°	184°	.723	.716	65°.0	67°. .	10
3	210°	200°	.737	.735	61°.0	62°. .	15
4	250°	218°	.752	.746	57°.5	59°.8	20
5	263°	222°	.767	.761	54°.0	56°.0	25
6	277°	218°	.778	.769	52°.0	53°.8	30
7	348°		.793	.777	48°.0	52°.0	35
8	354°	256°	.806	.791	45°.0	48°.5	40
9	370°	308°	.814	.808	43°.+	45°.0	45
10	400°	316°	.824	.818	41°.0	42°.5	50
11	427°	355°	.831	.834	40°.0	39°.0	55
12		425°	.830	.850	40°.0	36°.0	60
13	476°	430°	.831	.860	39°.0	34°.0	65
14	486°	490°	.835	.874	40°.0	31°.0	70
15	490°	490°	.834	.877	39°.0	30°.5	75
16	486°	484°	.830	.858	40°.0	33°.8	80
17	468°	500°	.825	.853	41°.0	34°.8	85
18	450°	485°	.826	.846	41°.+	36°.5	90
	Residuum		Solid at ordinary t°	Solid at ordinary t°			95
	"		"	"			100

\*C.F. Mabery (Am. Chem. Jr., 13, 232) notes that the sulphur compounds collect principally in the distillates of higher boiling points (200°-300°).



The first nine Lima distillates (45 per cent. of the original sample) were water white and have remained so for many months. They were not "refined," but were corked up and set aside immediately after taking the specific gravity.

The tenth distillate was straw yellow, and the color increased to a dark brown in the eighteenth.

The first eight (40 per cent. of the crude oil) of the California distillates were water white, and have remained so.

The ninth was slightly yellow and color increased in the succeeding distillates.

#### APPROXIMATE CLASSIFICATION OF DISTILLATES.

	Lima.	California.
Naphtha under 0.73 sp. gr. ....	10% +	10% +
Illuminating oil.....	50% ±	40% ±
"Lubricating" oils.....	30% ±	40% ±
Residuum.....	10% —	10% —

The California oil contained :

Sulphur (method of Carius).....	0.18 %
Sulphuric acid (oil washed and washings, represented by Ba Cl <sub>2</sub> ).....	0.0003%
Water.....	0.27%
Paraffine.....	none separable.

The oil remained perfectly fluid at — 26° F. (— 32 C.) the viscosity at that temperature being apparently equal to that of "boiled" linseed oil. The heaviest distillates solidified at 0° F. (— 18° C.).

A second sample of Lima oil, received at about the same time as the foregoing, was a somewhat heavier oil. Sp. gr. 0.850 = 36° B., but not differing noticeably in appearance or odor.

It was separated into the following temperature fractions :

At 150° F .....	0.0 %	Sp. gr. — = — ° B.
" 250° .....	13.75%	0.747 = 59.°
" 400° .....	35.11%	.797 = 47.°
" 500° .....	7.93%	.830 = 39.°
" 600° .....	13.40%	.844 = 36.5°
" 600° + .....	18.60%	.846 = 36.°
Residuum.....	9.65%	---
Water.....	0.70%	---

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99.14

**APPROXIMATELY :**

Naphtha and burning oil	56.8%
Heavy oils	32.0%
Residuum	9.6%
Water	0.7%
Sulphur, first determination	0.63%
Duplicate	0.68
Average	0.655%

Notwithstanding the strong odor of the Lima oil, the sulphur present seems rarely to amount to 1 per cent. "Analyses of samples of crude Ohio oils from different localities have given on the average about 0.50 per cent. sulphur" (C. F. Mabery and Albert W. Smith. *Loc. cit.*, p. 234).

Sulphur in crude Lima petroleum (average)	0.50%	Mabery & Smith.
“ “ “ “	0.553	Dr. Lord, Ohio Geol. Sur.
“ “ “ (by Carius' method)	0.655	D. Woodman.
Sulphur in crude distillate (Lima)	0.52	Dr. Lord
“ “ refined “ “	0.36	“
Another “ “ “	0.22	“
} “Economic Geology” vol., VI., p. 791.		
Sulphur in Pennsylvania crude oil	0.18	D. Woodman.
“ (by combustion)	0.22	“

The removal of the sulphur compounds or the destruction of those accountable for the disagreeable odor in Lima oil is a problem still open for a satisfactory solution both in respect to expense and efficiency.

The study of the individual forms in which the sulphur exists, although a most tedious process, holds the surest promise of success.

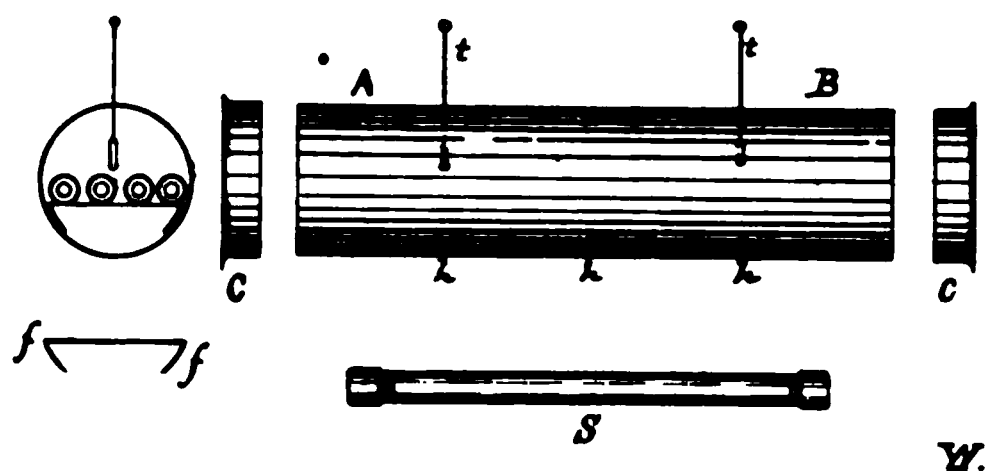
## AN APPARATUS FOR HEATING SEALED TUBES.

BY DURAND WOODMAN, Ph.D.

In a recent number of the *Journal of the Franklin Institute* Mr. Henry Pemberton describes an apparatus made of wrought iron pipe for heating sealed tubes.

Having occasion to make some analysis in 1889 which involved the sealed tube method, I constructed a somewhat similar apparatus which has, however, several advantages.

The oven is made as follows :



A length of 5-inch stove pipe, A B, is provided with a sheet iron cap at each end, C C, the caps not fitting so closely as to prevent being easily removed, as one of them must serve as the oven door.

A piece of sheet iron, *f f*, of the same length as the oven bent down at the edges may be fastened in place by four rivets to serve as a floor. Two holes are bored at suitable places in the top for thermometers *t t*, and three half-inch holes *h h*, in the bottom at equal distances from each other, under which Bunsen burners are placed.

The thermometers should not be placed directly over the burners as incorrectly shown in the figure.

A piece of rather heavy asbestos paper is wrapped around the oven and fastened with copper wire. Two discs of asbestos board are fitted into the end caps.

If desired, a suitable stand may be constructed of heavy galvanized wire but I have found it quite convenient to support the oven on the rings of two retort stands, fastening while in use with copper wire.

When not in use the oven requires very little storage space—if unencumbered with a special stand.

Three or four pieces of wrought iron pipe of 1-inch internal diameter, S, with screw caps at each end, complete the arrangement.

The properly sealed glass tubes are wrapped around several times in paper to prevent scratching by any roughness in the iron tube, pushed into place and the iron cap screwed on *with the fingers*.

It is not only unnecessary to screw up the cap so as to be steam tight, but it is as disadvantageous as it is inconvenient.

If the glass tube explodes, the gases escape with a hissing noise from the leaky iron cap, and while there is no other sound to startle neighbors (sometimes a matter of importance in city laboratories), the operator is apprised of the fact that the analysis is lost and does not waste time continuing to heat an exploded tube as would occur if he failed to hear the slight rustle accompanying the breakage of the glass tube enclosed steam tight in the iron pipe.

Heating the glass tube in an iron one has two important advantages :

(a). Uniform distribution of the heat is ensured.

(b). Flying glass and the noise of explosion are prevented.

It is thus possible to carry on such work in the midst of ordinary laboratory operations without inconvenience or danger.

The burners should not project into the oven but should stand under the half-inch holes made for the purpose, the flame tips just passing inside.

It will be found that they need not be turned very high to give a temperature of 300° C., and the uniform distribution of the heat is satisfactorily effected by the combined action of the sheet iron floor and the iron tubes which do not come in contact with the floor except at the end caps.

The advantages of the arrangement may be summed up as follows :

The oven costs but little.

The consumption of gas to heat it is very small.

It is not heavy and requires little storage space.

Several sealed tubes may be heated at once without the breakage of one affecting the others.

In case of breakage there is no noise and no flying glass.

The escape of the gases through the not too closely screwed up cap apprises the operator of the loss of a tube thus preventing further waste of time.

The safety of this method of procedure is absolute in all the ordinary cases of using the sealed tube method for analysis.

In experimental work on substances liable to yield products of high explosive power, extra precautions would be necessary.

## Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

Issued June 2d, 1891.

**453,227.**—Process of making steel. Riley P. Wilson, New York, N. Y.

**453,295.**—Tanning compositon. John T. Smith, San Francisco, and John W. Copeland, Redding, Cal.

A mixed decoction from the twigs, leaves and bark of the manzanita, eucalyptus, and madrona.

**453,299.**—Process of making phosphate of alumina. Charles Glaser, Baltimore, Md.

Insoluble phosphates of alumina or minerals containing same are first digested with a solution of an alkali so as to dissolve the phosphate of alumina. The resulting solution is separated from the insoluble matter and treated with carbonic acid which reprecipitates the phosphate of alumina, etc.

**453,300.**—Process of separating alumina from phosphates.

“The process of dissolving phosphate of alumina out of phosphatic material by the hot solution of a carbonate of an alkali, separating said phosphate of alumina as a precipitate from said solution by cooling, and using the remaining solution as a solvent for repetition of the operation.”

**453,304.**—Apparatus for tinning plates. Henry F. Taylor and William P. Struve, Briton Ferry, England.

**453,334.**—Soda motor. Robert R. Zell, Baltimore, Md.

**453,355.**—Process of coating metals with oxides. Alex. E. Haswell and Arthur G. Haswell, Vienna, Austria-Hungary.

Iron or steel is immersed in a bath of nitrate of lead and nitrate of ammonia solution, and an electric current passed through the bath whereby binoxide of lead is deposited upon the metal. Addition of manganous nitrate to the above bath will cause deposition of both binoxide of lead and binoxide of manganese when the electric current is passed through the bath.

**453,364.**—Cereal food and process of manufacturing it. Thomas B. Taylor, Jackson, Mich.

**453,386.**—Apparatus for produeing coal tar and coke. George Poterie, Alleghany, Pa.

**453,398.**—Composition blackboard. George W. Henry, Cherokee, Iowa.

Composition consists of sand, stucco, slaked lime, cement, lamp black, hair, black antimony, glue, marble dust, emery dust and water, etc.

**453,444.**—Method and apparatus for operating aqua-ammonia engines. Charles L. Horack, Brooklyn, N. Y.

**453,477.**—Blue-green dye. Albert Herrmann, Höchst-on-the-Main, Germany.

A blue-green coloring matter produced by converting metadiazotetralkyldiamidotriphenylmethanchloride into the corresponding metachlorleuco base by treatment with copper or cuprous chloride, sulphonation of the chlorleuco base and oxidation of the leuco-sulphonic acid thus obtained by means of peroxide of lead. The coloring matter is the "sulphonic acid of metachlortetralkyldiamidotriphenylcarbinol, a copper-red powder with metallic lustre, easily soluble in water, giving green coloring of difficult solubility in alcohol, not soluble in benzine, the green coloring of the aqueous solution turning yellow-green on the addition of an acid, and blue-green on the addition of ammonia or an alkali, and dyeing wool and silk blue-green shades in an acid bath."

**453,529.**—Process of smelting sulphides. William L. Austin, Toston, Mont.

**453,559.**—Method and apparatus for coating metals. George and William T. Leyshon, Tipton, England.

*Issued June 9th, 1891.*

**453,606.**—Apparatus for distilling wood. Alfred E. Badgley, Susquehanna, Pa.

**453,646.**—Apparatus for dyeing. Charles L. Klauder, Philadelphia, Pa.

**453,658.**—Device for steaming and bleaching fruit. Charles Phelan and Hackley Eldridge, Portland, Oreg.

**453,678.**—Apparatus for extracting lupuline. Jacob F. Theurer, Milwaukee, Wis.

**453,695.**—Secondary battery. William W. Griscom, Haverford College, Pa.

**453,735.**—Apparatus for the treatment of cane juice by filtration. Leon Boyer, New Orleans, La.

**453,749 and 453,750.**—Phosphatic fertilizers. Joseph Van Ruymbeke, Chicago, Ill.

**453,752.**—Process of an apparatus for the manufacture of gas. John F. Allen, New York, N. Y.

**453,758.**—Manufacture of Portland cement. Emil F. Baude, Cincinnati, Ohio.

**453,769.**—Ore roasting furnace. Joseph L. Giroux, Jerome, Ariz.

**453,774.**—Lime kiln or furnace. Hans Hanenschild, Berlin, Germany.

**453,801.**—Sulphuric acid concentrator. James B. Ackerson, Passaic, N. J.

**453,806.**—Apparatus for treating zinc ores. Eduard Grutzner, Romgne Grube, near Loslau, and Oscar Koehler, Czernitz, Germany.

**453,829.**—Process of recovering glycerine and salt from spent soap-lye. Albert Domeier and Otto C. Hagemann, London, Eng.

**453,884.**—Process of purifying and concentrating glycerine. Otto C. Hagemann, London, Eng.

**453,885.**—Recovering glycerine from spent soap-lye. Otto C. Hagemann, London, Eng.

**453,928.**—Ore concentrating and separating apparatus. Calvin M. Fitch, Chicago, Ill.

**453,975.**—Apparatus for bleaching vegetable and animal matter. Honore K. de Pawlowski, Paris, France.

**454,986.**—Process of distilling hydrochloric acid. Ernest Solvay, Brussels, Belgium.

*Issued June 16th, 1891.*

**454,061.**—Apparatus for distilling. Thomson McGowan. Cleveland, Ohio.

**454,071.**—Process for grading and concentrating ores. Hannibal Scovell, Portland, Colo.

**454,079.**—Process of vulcanizing rubber dentures. George B. Snow, Buffalo, N. Y.

**454,108.**—Manufacture of ammonia from sodium nitrate. Henry E. Boudouin and Elie T. Deloit, Paris, France.

Nitrate of soda is subjected to the action of nascent hydrogen at a given temperature whereby the nitrate is decomposed, also by mixing the nitrate of soda with a suitable hydrocarbon and then subjecting the mixture to heat sufficient to decompose the hydrocarbon. In this operation sodium carbonate is obtained as a by-product.

**454,136.**—Manufacture of caustic alkali. Adolf Kayser, Buffalo, N. Y.

**454,137.**—Process of making sodium aluminate. Adolf Kayser, Buffalo, N. Y.

**454,189.**—Process of making soda-alum. Francis M. and David D. Spence, Manchester, and Alex. Esilman, Southport, Eng.

A concentrated solution of sulphate of alumina of sp. gr. 1.3 is first prepared, then sufficient sulphate of soda is added to the hot solution to form with the sulphate of alumina soda-alum. The suspended impurities are removed and the solution then concentrated to 1.425 to 1.450 cooled and crystallized.

**454,209.**—Process of melting iron. Henry J. Graf, St. Louis, Mo.

**454,223.**—Compound of antipyrine and iodine. Eugene Ostermayer, Erfurt, Germany.

In the crude state a yellowish-brown powder, in the pure state brilliant white prismatic needles melting at 158° to 160° C., nearly insoluble in water, readily soluble in alcohol, having the formula  $C_{11}H_{11}IN_2O$ .

**454,239.**—Explosive. Paul Ward and Edward M. Gregory, London, Eng.



A detonating composition consisting of powdered coke, amorphous phosphorous, chlorate of potash and paraffine oil.

**454,281.**—Method for making gun cotton. Hiram S. Maxim, London, Eng.

**454,340.**—Filter. Jacob A. Fulton, Astoria, Oreg.

**454,346.**—Artificial stone. George E. Hagerman, Brooklyn, N. Y.

Sand or rock is reduced to a molten state, run into suitable molds and mixed with fresh sand.

**454,381.**—Process of electro-deposition and cathode therefor. Alex. C. Reinfeld, Vienna, Austria-Hungary.

**454,409.**—Apparatus for the manufacture of gas. John L. Stewart, Philadelphia, Pa.

**454,442.**—Production of waste rubber goods. Nathaniel C. Mitchell, Philadelphia Pa.

*Issued June 23d, 1891.*

**454,531.**—Apparatus for the manufacture of gas. Charles Stilwell, Trenton, N. J.

**454,535.**—Gray dye. Albert Cobenzl, Höchst-on-the-Main, Germany.

A gray coloring matter derived from nitroso-diethylaniline and the betanaphtholmonosulphonic acid of Schaffer; a black amorphous powder readily soluble in water with violet coloration insoluble in acetone, benzine and alkaline solution. An addition of acid to the hot dilute aqueous solution turning the color of the solution into blue-green and in concentrated solutions forming a green-blue precipitate, the filtered colorless solution exposed to the air rapidly reassuming the violet coloration, this violet solution acidulated turning into green and forming a green-blue precipitate.

**454,575.**—Pepsin. Joseph Le R. Webber, Detroit, Mich.

**454,645.**—Amidonaphtholmonosulphonic acid. Leo Gans, Frankfort, Germany.

**454,759.**—Ore roasting dish. William F. Oden, Butte City, Mont.

**454,777.**—Process of solidifying liquid hydrocarbons.

A pulverized vegetable saponifier is first added to the hydrocarbon and then water is added and intimately mixed with the mixture.

**454,817.**—Filtering apparatus. John E. Warren, Cumberland Mills, Me.

*Issued June 30th, 1891.*

**454,835.**—Process of making artificial leather. Alfred E. Arnold, Marrickville, New South Wales.

**454,840.**—Orange dye. Otto Borgmann, Berlin, Germany.

**454,856.**—Apparatus for the manufacture of ultramarine. Frederick Curtius-Brockhoff, Duisberg, Germany.

**454,925.**—Process of manufacturing gas. William G. Wood, Windsor, Canada.

**455,078.**—Process of manufacturing lactic acid. Charles N. Waite, Newton, Mass.

**455,102.**—Process of carbonating liquids. Hermann Hübener, Berlin, Germany.

**455,164.**—Apparatus for extracting gold and silver from their ores by electrical amalgamation. George Button and William E. Wyeth, Kimberley, Griqualand, West Africa.

**455,210.**—Milk wine and process of making the same. John H. Hooker, Winslow, Eng.

**455,217.**—Explosive compound. Carl Lamm, Stockholm, Sweden.  
An explosive compound composed of a nitrate salt and dinitro-benzine or dinitro-benzol.

**455,227.**—Process of making compounds of nickel and carbon monoxide. Ludwig Mond, London, Eng.

**455,228.**—Process of obtaining metallic nickel. Ludwig Mond, London, Eng.

**455,229.**—Compound of nickel and carbon monoxide. Ludwig Mond, London, Eng.

A new compound of nickel and carbon monoxide of the formula  $\text{Ni C}_4 \text{O}_4$ , a liquid boiling at about  $43^\circ \text{C}$ . under atmospheric pressure, but very volatile in the presence of other gases, at ordinary temperature.

**455,230.**—Process of depositing nickel. Ludwig Mond, London, Eng.

**455,245.**—Manufacture of pyroxyline. Hilaire de Chardonnet, Besancon, France.

**455,286.**—Process of making water proof compositions from linseed oil. Henry Kellogg, New Haven, Conn.

**455,295.**—Method of treating molasses to improve its flavor. James Duncan, Selby, Eng.

J. F. G.



*Journal of the American Chemical Society*

## THE WASHINGTON MEETING.

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The third general meeting of the American Chemical Society was held at Washington August 17 and 18, 1891.

A conference of chemists representing many different organizations was held at the same time to consider further the question of more general organization of chemists in America. The result of this conference has been a substantial agreement on the part of the chemists present to recommend the union, under the name and organization of the American Chemical Society, of all the members of the different societies represented, and the reorganization of local chemical societies as local sections of the American Chemical Society. In pursuance of this recommendation the chemists of New York and vicinity have already taken steps to organize a New York section of the Society and it is expected that other chemists throughout the country will take similar action.

Certain modifications of the charter and constitution of the Society, which were suggested at the conference, will be decided upon at the next general meeting of the Society.

## PROCEEDINGS.

### FIRST DAY'S SESSION.

Monday, August 17, 1891.

The meeting was called to order at 10:50 A. M., in the Lecture Hall of the Columbian University. President Geo. F. Barker in the chair. The meeting was opened with a short address by the president.

The following nominations were made :

#### AS MEMBERS.

Jas. T. Anderson, Auburn, Alabama.

H. W. Austin, 1834 Jefferson place, Washington, D. C.

George H. Baert, Pn. C., West Lafayette, Indiana.

W. G. Berry, Chemist Health Dept., N. Y. City.  
A. A. Bennett, Ames, Iowa.  
M. Bird, North Louisiana, Experiment Station, Calhoun, La.  
Arthur Lee Brown, 21 Spruce street, New York, N. Y.  
E. A. Congdon, 18 Broadway, N. Y.  
Henry E. Curtis, Lexington, Ky.  
L. M. Dennis, Asst. Prof. Anal. Chem., Cornell Univ., Ithaca, N. Y.  
George H. Ellis, A. B., Evanston, Illinois.  
H. H. Harrington, College Station, Texas.  
J. H. Kastle, Lexington, Ky.  
B. W. Kilgore, Raleigh, North Carolina.  
J. H. Long, Ph. D., Chicago Med. College, Chicago, Ill.  
N. W. Lord, Ohio State Univ., Columbus, Ohio.  
S. R. McKee, Matthews, North Carolina.  
Herbert Marsland, Lincoln, Nebraska.  
John A. Meyers, W. Va. Agr. Expt. Sta., Morgantown, Va.  
G. W. Miles, Jr., 55 Fulton street, New York, N. Y.  
G. E. Patrick, Agl. College & Exp. Sta., Ames, Iowa.  
A. M. Peter, Chemist Ag. Exp. Sta., Lexington, Ky.  
William Robertson, 68 Meeting street, Charleston, S. C.  
Rudolph J. J. De Roode, Morgantown, W. Va.  
B. B. Ross, Baton Rouge, La.  
Edgar F. Smith, Ph. D., Univ. of Penna., Philadelphia, Pa.  
Chas. A. Schaeffer, Ph. D., Iowa City, Iowa.  
Dr. Hans von Strombeck, De La Vergne Ice Machine Co., N. Y.  
W. C. Stubbs, Audubon Park, La.  
A. R. Whitehill, Morgantown, W. Va.

## AS ASSOCIATES.

Dr. E. A. Goodridge, Flushing, N. Y.  
Chas. E. Keaton, Nostrand and Park aves., Brooklyn, N. Y.  
W. C. Tiffany, 21 Spruce street, New York, N. Y.  
C. F. Vanderford, University of Tenn., Knoxville, Tenn.  
David S. Wood, Flushing, N. Y.

The reading of papers was then taken up. The following papers were read :

- I. "A New Form of Voltameter," by G. C. Caldwell.
- II. "A Theory of the Chlorite and Mica Groups." F. W. Clarke.
- III. "On the Occurrence of Tin in Canned Goods." H. A. Weber.
- IV. "On the Composition of American and European Chestnuts." Wm. Frear.

The meeting was then adjourned until August, 18th, at 10 A.M.

DURAND WOODMAN,  
*Recording Secretary.*

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SECOND DAY'S SESSION.

Tuesday, Aug. 18, 1891.

The meeting was called to order at 11 A. M. in the lecture room of the Columbian University, President G. F. Barker in the chair.

The minutes of the previous session were read and accepted. The following nominations were made :

W. W. COOKE, Agr. Expt. Station, Burlington, Vt.  
PROF. WILLIAM FREAR, State College, Centre Co., Pa.  
WM. HUTCHINSON, M. D., 207 Clinton st., Brooklyn, N. Y.  
J. C. MIMS, 124 Bryan st., Savannah, Ga.  
CLIFFORD RICHARDSON, Washington, D. C.  
LOTHAR STERNBERG, Am. Sugar Refining Co., Jersey City, N. J.  
CHARLES WELLINGTON, Amherst, Mass.  
DAVID WESSON, B. S., Wilson Lard Co., Guttenberg, N. J.  
PROF. L. W. WILKINSON, Agr. and Mech. College Auburn, Neb.

The following papers were then read :

I. Identification of Arsenic and Antimony, by Jas. T. Anderson.

II. "On Acid Sulphate of Lime," by H. Endemann.

III. "On Gluten," by H. Endemann.

IV. "On the nature and origin of the Asphalt from the Island of Trinidad," by Clifford Richardson.

V. "Some characteristics of Pinite," by H. W. Wiley. Read by title.

VI. "On Metatitanic Acid," F. P. Dunnington.

Prof. Breneman moved that the thanks of the Society be tendered to Prof. F. W. Clarke and the members of the Washington Chemical Society for their courtesies, also to the authorities of the Columbian University for the use of the building. Carried.

Prof. Barker congratulated the Society on the large attendance and on the interest taken in the meetings and expressed his best wishes for the movement which looks towards the complete organization of the chemists of the country.

The Third General Meeting was then adjourned.

DURAND WOODMAN,  
*Recording Secretary.*

## THE CONFERENCE.

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A conference meeting of committees representing the following chemical bodies met at 9:30 P. M., Aug. 17th, in the Columbian University, Washington, D. C.

*The American Chemical Society.*—G. F. Barker, A. A. Breneman, G. C. Caldwell, William McMurtrie, A. H. Sabin, H. H. Nicholson, R. W. Hall—290 members.

*The Association of Official Agricultural Chemists.*—H. W. Wiley, N. P. Lupton, G. C. Caldwell, W. C. Stubbs, William Frear—75 members.

*The Chemical Section of the American Association for the Advancement of Science.*—F. W. Clarke, T. H. Norton, Morris Loeb, Edward Hart—200 members.

*The Chemical Section of the Franklin Institute.*—Henry, Pemberton, Jr.—70 members.

*The Washington Chemical Society.*—Edgar Richards, F. P. Dewey—70 members.

*The Chemical Section of the Brooklyn Institute.*—W. H. Kent—75 members.

*The Louisiana Sugar Chemists' Association.*—C. A. Crampton—52 members.

*The Chemical Society of the University of Michigan.*—A. B. Prescott—60 members.

*The Cincinnati Chemical Society.*—Alfred Springer—29 members.

*The Manufacturing Chemists' Association of the United States.*—Henry Bower.

Prof. A. B. Prescott was made chairman of the conference. Three sessions of the conference were held, on Monday evening, August 17th, and on Tuesday morning and Tuesday afternoon, August 18th, respectively.

The subject of the general organization of chemists in America was very fully considered. The work of the conference is best summed up in the following resolution, which was carried unanimously :

*Resolved*, That it is the opinion of this conference, 1st. That the American Chemical Society be so extended as to include the members of all local societies in its membership ; 2d. That the New York members of the American Chemical Society be requested to organize a local section of the American Chemical Society in New York.

Conference adjourned.



## THE SEPTEMBER MEETING.

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REGULAR MEETING, SEPTEMBER 4, 1891.

The regular meeting of the Society was held in the Law Lecture Room of the University Building at 8:30 P. M.

Vice-President Breneman in the chair.

The minutes of the Washington meeting were read and accepted.

The following were elected.

### AS MEMBERS.

Jas. T. Anderson, Auburn, Alabama.

H. W. Austin, 1834 Jefferson place, Washington, D. C.

George H. Baert, Ph. C., West Lafayette, Indiana.

W. G. Berry, Chemist Health Dept., N. Y. City.

A. A. Bennett, Ames, Iowa.

M. Bird, North Louisiana, Experiment Station, Calhoun, La.

Arthur Lee Brown, 21 Spruce street, New York, N. Y.

E. A. Congdon (Drexel Institute), 31 Broadway, N. Y.

Henry E. Curtis, Lexington, Ky.

L. M. Dennis.

George H. Ellis, A. B., Evanston, Illinois.

H. H. Harrington, College Station, Texas.

J. H. Kastle, Lexington, Ky.

B. W. Kilgore, Raleigh, North Carolina.

J. H. Long, Ph. D., Chicago Med. College, Chicago, Ill.

N. W. Lord, Ohio State Univ., Columbus, Ohio.

S. R. McKee, Matthews, North Carolina.

Herbert Marsland, Lincoln, Neb.

John A. Meyers, W. Va. Agricultural Expt. Station, Morgantown, Va.

G. W. Miles, Jr., 55 Fulton street, New York, N. Y.

G. E. Patrick, Agl. College & Exp. Sta., Ames, Iowa.

A. M. Peter, Chemist Agr. Exp. Sta., Lexington, Ky.

William Robertson, 68 Meeting street, Charleston, S. C.  
 Rudolph J. S. De Roode, Morgantown, W. Va.  
 B. B. Ross, Baton Rouge, La.  
 Edgar F. Smith, Ph. D., Univ. of Penna., Philadelphia, Pa.  
 Chas. A. Shaeffer, Ph. D., Pres't State Univ., Iowa City, Iowa.  
 Dr. Hans von Strombeck, De La Vergne Ice Machine Co., N. Y.  
 W. C. Stubbs, Audubon Park, La.  
 A. R. Whitehill, Morgantown, W. Va.  
 W. W. Cooke, Agr. Expt. Station, Burlington, Vt.  
 Prof. William Frear, State College, Centre Co., Pa.  
 Wm. Hutchinson, M. D., 207 Clinton St., Brooklyn, N. Y.  
 J. C. Mims, 124 Bryan st., Savannah, Ga.  
 Clifford Richardson, Washington, D. C.  
 Lothar Sternberg, American Sugar Refining Co., Jersey City,  
 N. J.  
 Charles Wellington, Amherst, Mass.  
 David Wesson, B. S., Wilson Lard and Refining Co., Gutten-  
 berg, N. J.  
 Prof. L. W. Wilkinson, Agr. and Mech. College, Auburn, Neb.  
 The following nominations were made :

AS AN HONORARY MEMBER.

Jean Servais Stas, Brussels, Belgium.

AS MEMBERS.

George E. Barton, Torpedo Station, Newport, R. I.  
 Philip E. Chazal, E. M., No. 68 Meeting St., Charleston, S. C.  
 F. W. Clarke, National Museum, Washington, D. C.  
 A. R. L. Dohme, Ph. D., care of Sharp & Dohme, Baltimore, Md.  
 Walter G. Graves, Miller, Lake Co., Indiana.  
 John A. Miller, Ph. D., Niagara University, Buffalo, N. Y.  
 H. Pemberton, Jr., 1947 Locust St., Philadelphia, Pa.  
 Mark Powers, Chicago Medical College.  
 A. L. Smith, Ph. D., Englewood, Ill., Box 263.  
 Clarence L. Speyers, Rutgers College, New Brunswick, N. J.  
 Harvey W. Wiley, Washington, D. C.

## AS ASSOCIATES.

Dr. E. A. Goodridge, Flushing, N. Y.

Chas. E. Keaton, Nostrand and Park aves., Brooklyn, N. Y.

W. C. Tiffany, 21 Spruce street, New York, N. Y.

C. F. Vanderford, University of Tenn., Knoxville, Tenn.

David S. Wood, Flushing, N. Y.

Prof. Breneman, as chairman of the Washington Conference Committee of the Society, then made an oral report of the conference at Washington and read the minutes of the same as furnished by the secretary, Dr. Springer.

Mr. Geisler moved that the report be accepted and the committee discharged. Carried.

The following papers were then read :

I. Raphides the cause of Acridity in certain Plants, by H. A. Weber, Ph. D. Read by the secretary in the absence of the author.

II. "On an Error in the present Official Method for the determination of Albuminoid Nitrogen, and the effect of the presence of Metals precipitable by Potassium Sulphide in the Determination of Nitrogen by the Kjeldahl Method," by Harry Snyder, Ph. D. Read by the Secretary in the absence of the author.

Miscellaneous business was then taken up, the chair asking what action was to be taken by the Society in regard to forming a local section in New York, as advised by the Conference Committee.

Prof. Hale: "It is necessary to know whether, under our constitution, we can make this change. Probably there is nothing to prevent the formation of a local section here if it is done in the right way."

The Chair: "A committee has been appointed for inspecting the law under which the Society is incorporated. At present an expression of opinion is all that can be given."

Prof. McMurtrie: "I think we should confirm any provisional agreement made by the conference committee."

Dr. Morris Loeb: "I think the Society should show at its

first meeting whether it desires to confirm the action of its committee."

Prof. McMurtrie moved: "That the action of the committee of conference at Washington be approved and that the Society take action in regard to it."

Prof. Hale offered as a substitute for the previous motion: "That the action of the committee of conference at Washington be approved, and that its recommendations be adopted." Seconded and carried.

Prof. Hale further moved: "That the matter be referred to the Board of Directors, and that they be requested to report upon the matter as soon as possible." Carried.

Mr. Geisler moved: That the Society extend to the Conference Committee a vote of thanks for the successful efforts they have made in behalf of the American Chemical Society in bringing to a harmonious issue the matter of the more general organization of the chemists of America. Seconded and carried.

The meeting was then adjourned.

DURAND WOODMAN,  
*Recording Secretary.*

## ON THE OCCURRENCE OF TIN IN CANNED FOOD.

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BY H. A. WEBER, PH. D.

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The following investigation of the condition of foods packed in tin cans was prompted by an alleged case of poisoning, which occurred at Mansfield, Ohio, in April, 1890. A man and woman were reported to the writer as having been made sick by eating pumpkin pie made from canned pumpkin. The attending physician pronounced the case one of lead poisoning. The wholesale dealer from whose stock the canned pumpkin originally came, procured a portion of the same at the house where the poisoning occurred, and sent it to the writer for examination.

The results of the examination as reported in Serial No. 552, below, showed that the canned pumpkin contained an amount of stannous salts equivalent to 6.4 maximum doses and 51.4 minimum doses of stannous chloride per pound. On being notified of this fact, the dealer sent a can of the same brand of pumpkin from his stock. The inner coating of the can was found to be badly eroded, and upon examination, as reported in Serial No. 563, below, one pound of the pumpkin contained tin salts equivalent to 7 maximum and 56 minimum doses of stannous chloride.

The unexpected large amount of tin salts in such an insipid article as canned pumpkin, and the claimed ill effects of the consumption of the same, suggested the advisability of extending the investigation to other canned goods in common use. Accordingly a line of articles was purchased in open market as sold to consumers, no pains being taken to procure old samples. The collection embraced fruits, vegetables, fish and condensed milk. With the exception of the condensed milk, every article examined was contaminated with salts of tin. In most cases the amount

of tin salts present was so large that there can be no doubt of danger to health from the consumption of the food, especially if several kinds are consumed at the same meal.

### METHOD.

The method employed in the determination of the tin was simply as follows :

The contents of each can were emptied into a large porcelain dish, and the condition of the inner coating of the can noted. After thoroughly mixing the contents, fifty grams were weighed off and incinerated in a porcelain dish of suitable size. The residue was treated with a large excess of concentrated hydrochloric acid, evaporated to dryness, moistened with hydrochloric acid, water was added, and the mass was filtered and washed, the insoluble matter being all washed upon the filter. After drying the filter with its contents, the whole was again incinerated in a porcelain dish and the residue treated as before. The solution thus obtained was properly diluted and saturated with hydrogen sulphide. After standing about twelve hours in a covered beaker the precipitate was filtered off and the tin weighed as stannic oxide.

### RESULTS OF EXAMINATION.

*Serial No. 552.*—Sample of canned pumpkin, received of F. A. Derthick, April 22, 1890, sent by Albert F. Remy & Co., Mansfield, Ohio. Pie made from it supposed to have made a man and woman sick. The attending physician pronounced the case one of lead poisoning.

Tin dioxide with trace of lead .....	0.0424%
Grains per pound .....	2.97
Equivalent to stannous chloride .....	3.74
Minimum doses .....	51.4
Maximum doses .....	6.4

*Serial No. 563.*—Sample of canned pumpkin, received of Edward Bethel, June 27, 1890. Labeled : Choice Pie Pumpkin, packed at Salem, Columbiana County, Ohio, by G. B. McNabb, sent by A. F. Remy & Co., Mansfield, Ohio.

Tin dioxide.....	0.0444%
Grains per pound.....	3.11
Equivalent to stannous chloride.....	3.91
Minimum doses.....	56.
Maximum doses.....	7.

Can eroded.

*Serial No. 565.*—Sample of canned pumpkin, bought of T. B. Vaure, July 11, 1890. Labeled: Belpre Pumpkin, Golden. George Dana & Sons, Belpre, Ohio.

Tin dioxide.....	0.0054%
Grains per pound.....	0.38
Equivalent to stannous chloride.....	0.48
Minimum doses.....	7.7
Maximum doses.....	1.0

Can eroded.

*Serial No. 566.*—Sample of canned Hubbard Squash, bought of T. B. Vaure, July 11, 1890. Labeled: Ladd Brand, L. Ladd, Adrian, Michigan.

Tin dioxide.....	0.026%
Grains per pound.....	1.85
Equivalent to stannous chloride.....	2.33
Minimum doses.....	37.00
Maximum doses.....	4.7

Can badly eroded.

*Serial No. 567.*—Sample of canned tomatoes, bought of T. B. Vaure, July 11, 1890. Labeled: Extra Fine Tomatoes. Blue Label. Curtice Bros. Co., Rochester, N. Y.

Tin dioxide.....	0.012%
Grains per pound.....	0.84
Equivalent to stannous chloride.....	1.06
Minimum doses.....	16.00
Maximum doses.....	2.00

Inner coating eroded.

*Serial No. 568.*—Sample of canned tomatoes, bought of T. B. Vaure, July 11, 1890. Labeled: Fresh Tomatoes, Curtice Bros Co., Rochester, N. Y.

Tin dioxide.....	0.014%
Grains per pound.....	0.98
Equivalent to stannous chloride.....	1.23
Minimum doses.....	19.00
Maximum doses.....	2.5

Can eroded.

*Serial No. 569.*—Sample of canned peas, bought of T. B. Vaure, July 11, 1890. Labeled : Petites Pois, P. Emillien, Bordeaux.

Copper oxide.....	0.0294%
Grains per pound.....	2.06
Equivalent to copper sulphate.....	3.95
Tin dioxide.....	0.0068
Grains per pound.....	0.48
Equivalent to stannous chloride.....	.60
Minimum doses.....	9.6
Maximum doses.....	1.2

No visible erosion.

*Serial No. 570.*—Sample of canned mushroom, bought of T. B. Vaure, July 11, 1890. Labeled : Champignons de Choix. Boston fils. Paris.

Tin dioxide.....	0.020%
Grains per pound.....	1.40
Equivalent to stannous chloride.....	1.76
Minimum doses.....	28.
Maximum doses.....	3.5

Inner coating highly discolored.

*Serial No. 571.*—Sample of canned blackberries, bought of T. B. Vaure, July 11, 1890. Labeled : Lawton Blackberries. Cur-tice Bros. Co., Rochester, N. Y.

Tin dioxide.....	0.0114%
Grains per pound.....	0.80
Equivalent to stannous chloride.....	1.01
Minimum doses.....	16.
Maximum doses.....	2.

Inner coating eroded.



*Serial No. 572.*—Sample of canned blueberries, bought of T. B. Vaure, July 11, 1890. Labeled: Blueberries. Eagle Brand, packed by A. & R. Loggie, Black Brook, N. B.

Tin dioxide.....	0.03%
Grains per pound.....	2.10
Equivalent to stannous chloride.....	2.64
Minimum doses.....	42.00
Maximum doses.....	5.3

Can badly eroded.

*Serial No. 574.*—Sample of canned salmon, bought of T. B. Vaure, July 11, 1890. Labeled: Best Fresh Columbia River Salmon, Eagle Canning Co., Astoria Clatsop Co., Oregon.

Tin dioxide.....	0.0134%
Grains per pound.....	0.94
Equivalent to stannous chloride.....	1.18
Minimum doses.....	18.9
Maximum doses.....	2.3

Inner coating eroded.

*Serial No. 578.*—Sample of canned pears, received of Mr. Edward Bethel, July 29, 1890. Labeled: Bartlett Pears. Solan's Brand, Packed in Solano Co., California.

	Juice.	Fruit.
Tin dioxide.....	0.0074%	0.0074%
Grains per pound.....	0.518	0.518
Equivalent to stannous chloride....	0.65	0.65
Minimum doses.....	10.4	10.4
Maximum doses.....	1.3	1.3

Can eroded.

*Serial No. 579.*—Sample of canned peaches, received of Edward Bethel, July 29, 1890. Labeled: Peaches, Wm. Maxwell, Baltimore, U. S. A.

	Juice.	Fruit.
Tin dioxide.....	0.0324%	0.0414%
Grains per pound.....	2.268	2.898
Equivalent to stannous chloride....	2.85	3.65
Minimum doses.....	45.6	58.4
Maximum doses.....	5.7	7.3

Can badly eroded.

*Serial No. 580.*—Sample of canned blackberries, received of Edward Bethel, July 29, 1890. Labeled : Blackberries, Clipper Brand, Wm. Munson & Sons, Baltimore, Md.

Tin dioxide.....	0.060%
Grains per pound.....	4.20
Equivalent to stannous chloride.....	5.28
Minimum doses.....	84.0
Maximum doses.....	10.6

Can badly eroded.

*Serial No. 581.*—Sample of canned cherries, received of Edward Bethel, July 29, 1890. Labeled : Red Cherries, Cloverdale Brand, G. C. Mournaw & Co., Cloverdale, Va.

Tin dioxide.....	0.0414%
Grains per pound.....	2.898
Equivalent to stannous chloride.....	3.65
Minimum doses.....	58.4
Maximum doses.....	7.3

Can badly eroded.

*Serial No. 582.*—Sample of canned pumpkin, received of Edward Bethel, July 29, 1890. Labeled : Royal Pumpkin, Urbana Canning Co., Urbana, Ohio.

Tin dioxide.....	0.0184%
Grains per pound.....	1.299
Equivalent to stannous chloride.....	1.62
Minimum doses.....	25.9
Maximum doses.....	3.2

Can eroded.

*Serial No. 583.*—Sample of canned baked sweet potatoes, received of Edward Bethel, July 29, 1890. Labeled : Tennessee Baked Sweet Potatoes, Capital Canning Co., Nashville, Tenn.

Tin dioxide.....	0.0132%
Grains per pound.....	0.92
Equivalent to stannous chloride.....	1.16
Minimum doses.....	18.5
Maximum doses.....	2.3

Can eroded.

*Serial No. 584.*—Sample of canned peas, received of Edward Bethel, July 29, 1890. Labeled : Marrowfat Peas, Parson Bros., Aberdeen, Maryland.

Tin dioxide.....	0.0044%
Grains per pound.....	0.30
Equivalent to stannous chloride.....	0.38
Minimum doses.....	6.2
Maximum doses.....	0.8
Can slightly eroded.	

*Serial No. 585.*—Sample of string beans, received of Edward Bethel, July 29, 1890. Labeled : String Beans. Packed by H. P. Hemingway & Co., Baltimore City, Md.

Tin dioxide.....	0.0154%
Grains per pound.....	1.08
Equivalent to stannous chloride.....	1.36
Minimum doses.....	21.7
Maximum doses.....	2.7
Can eroded.	

*Serial No. 586.*—Sample of canned salmon, received of Edward Bethel, July 29, 1890. Labeled : Puget Sound Fresh Salmon, Puget Sound Salmon Co., W. T.

Tin dioxide.....	0.0044%
Grains per pound.....	0.30
Equivalent to stannous chloride.....	0.38
Minimum doses.....	6.20
Maximum doses.....	0.8
Can slightly eroded.	

*Serial No. 587.*—Sample of condensed milk, received of Edward Bethel, July 29, 1890. Labeled : Borden's Condensed Milk. The Gail Borden Eagle Brand, New York Condensed Milk Co., 71 Hudson street, New York :

Tin dioxide.....	none.
No visible erosion.	

*Serial No. 592.*—Sample of canned pineapples, bought of Mr. Brown, Fifth avenue, August 4, 1890. Labeled: Pineapples, First Quality. Packed by Martin Wagner & Co., Baltimore, Md.

Tin dioxide.....	0.0098%
Grains per pound.....	0.686
Equivalent to stannous chloride.....	0.864
Mininum doses.....	13.6
Maximum doses.....	1.7

Can eroded.

*Serial No. 593.*—Sample of canned pineapples, bought of Mr. Brown, Fifth avenue, August 4, 1890. Labeled: Florida Pineapple, Oval Brand. Extra Quality. A. Booth Packing Co., Baltimore, Md.

Tin dioxide.....	0.0158%
Grains per pound.....	1.11
Equivalent to stannous chloride.....	1.4
Mininum doses.....	22.4
Maximum doses.....	2.8

Can eroded.

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## A NEW FORM OF VOLTAMETER.

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BY DR. G. C. CALDWELL.

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In the recent development of electrolytic analysis it has come to be shown that a more careful adjustment of the strength of the current is essential, and that for much of the work very weak currents, evolving even as little as 0.1 or 0.2 c.c. of oxy-hydrogen gas per minute must be used for the best results; and it is not often, for any practicable determinations, that a current yielding over 10 c.c. per minute is required.

Therefore a voltmeter that will readily show in its upper part tenths of a cubic centimeter is essential, and with a total capacity of 10 c.c. in its measuring tube is quite large enough, while in the measurement of the stronger currents the accurate reading to tenths is not important.

Classen's voltmeter is familiar to those who make much use of electrolytic analysis. With its capacity of 30 c.c. it is unnecessarily cumbersome; and it is practically impossible to prevent slow leakage of the acid liquid when the rubber tube connects with the glass tubes. Other voltmeters figured or described in the apparatus lists are now no more convenient.

For my own use I have devised the arrangement, made for me by Greiner, shown in the figure. It needs little explanation.



The lower stop cock is three-way, so that the two tubes can be connected with one another, or each or both with the outflow jet,

at pleasure. The distance from the lower to the upper stop cock is 21 cm., the diameter of the wider part of the graduated tube about 16 mm., the length of the narrow part, especially for measuring tenths, is 4 cm., and, as shown, this holds about 2 c.c.

The instrument is conveniently supported on a wooden stand, and held in place by two pieces of D violin strings, each piece having a loop at one end that passes over the head of a small screw in the side of the post, then through a small screw eye in front, then through a small hole in the shank of a larger screw eye in the other side of the post; by holding the end of the string cautiously near the lamp flame, it will swell sufficiently so that it cannot slip out through the hole again; then by turning the screw eye, a very little tightening of the string holds the instrument firmly in place.

Ordinary binding posts on the base of the stand can, of course, be used instead of the screw clamps; but with the wires from the electrodes soldered to these clamps, they serve the purpose well.

The acid electrolyte will leak even around a vaselined glass stopper, in time. But it is not at all essential to have an outflow at the bottom, especially if the reservoir tube is made somewhat wider than the other. The diminution of the volume of the gas under the pressure of the longer column of liquid in the reservoir tube is too small to be of account in this work. Even in my own instrument, with a reservoir tube only 17 mm. wide, when 2 c.c. have been collected, the change in volume by allowing the excess of liquid in the reservoir tube to flow out is inappreciable; when the level in the graduated tube has fallen to the mark for 9 c.c. and the reservoir tube is full to the top, the increase in volume is but 0.2 c.c. when both levels are brought to the same height. Without the three-way, outflow stop cock the instrument would, of course, be much cheaper and practically quite as serviceable.

CORNELL UNIVERSITY, July, 1891.

## IDENTIFICATION OF ARSENIC AND ANTIMONY.

BY JAMES T. ANDERSON.

The method of separating arsenic and antimony by passing  $H_2S$  and then dry  $HCl$  gas through the tubes in which the metals have been deposited as in Marsh's test, has been modified by the writer so as to be conveniently applied in cases where it is desired to identify as arsenic or antimony metallic deposits on porcelain.

Add a drop of ammonium sulphide to the deposit, which converts the metal into the sulphide. Allow the excess of ammonium sulphide to evaporate, and with an ordinary mouth blow-pipe blow across the open mouth of a bottle containing concentrated  $HCl$ , directing the stream of gas into the porcelain dish upon the sulphide. If it be antimony sulphide, it will disappear entirely, while arsenic sulphide will remain unaffected in appearance.

AGR. & MECH. COLLEGE, Auburn, Ala., July 27, 1891.

## ON METATITANIC ACID AND THE ESTIMATION OF TITANIUM BY HYDROGEN PEROXIDE.

BY PROF. F. P. DUNNINGTON.

The detection and estimation of small amounts of titanous acid which has long been very tedious and unsatisfactory, has been rendered exceedingly simple through the publication of A. Weller in the *Ber. d. Chem. Ges.*, 1882, of a method depending upon the production of a compound of intense yellow color by the addition of hydrogen peroxide to the solution of titanium.

Since its publication I have made considerable use of this method, but have recently noted a feature in the test which must be kept in view to avoid error. The solution of the melt obtained by fusion with acid sodium sulphate when made with dilute sulphuric acid of five or more per cent., gives constant results, which tally with those made gravimetrically; but when water only or very dilute acid is employed, one may obtain lower results. Upon one occasion a coloration was obtained which corresponded to only about one-third of the titanium, which was afterwards found to

be present. Moreover, if we take a slightly acid solution of titanium sulphate, dilute it and heat until it is partially precipitated, cool, redissolve with sulphuric acid and then add hydrogen peroxide, the yellow coloration will correspond to only a portion of the titanium present. I find an explanation of these facts in the formation of some meta-titanic acid. It is uniformly stated that when titanous acid is precipitated by heating a not too acid solution, it separates in the form of meta-titanic acid.

In order to further examine the metatitanic acid which was in part described by Weber (*Jahr.*, 1863, p. 210), I have isolated it as follows: Heat a dilute solution of titanium sulphate to 100° C.; gradually add ammonia to excess, filter, treat the washed precipitate with hydrochloric acid and warm; there results a residue which is nearly insoluble in strong hydrochloric acid. Now wash this once or twice by decantation with cold water, and, when most of the hydrochloric acid is removed, there will be left a mass perfectly and readily soluble in cold water.

Again, if the above precipitate is treated with hydrochloric acid, and then evaporated upon the water bath to remove the latter acid, there is left a mass of scales of a gummy appearance, which dissolves in a moderate amount of water, giving an opaline solution. This substance is practically free from chlorine and contains one molecule of water to one of titanous acid—and so presents the composition of the air dried metatitanic acid of Merz. If either of these water solutions of meta-titanic acid be treated with hydrogen peroxide, it will not be colored yellow, but afford a white precipitate.

It therefore appears probable that after the fusion of titanous oxide with acid sodium sulphate, if the melt is digested in water only, the solution of the free acid may occasion sufficient heat to form some metatitanic acid, which when redissolved by the further admixture of acid would not be colored by the hydrogen dioxide.

And we conclude that in making the estimation of titanium by the method of A. Weller, the "melt," after cooling, is to be digested in dilute sulphuric acid of such strength as will prevent the formation of a precipitate even in warm solutions of titanous sulphate; for this purpose 5 per cent. acid is found to answer.

UNIVERSITY OF VIRGINIA, August, 1891.



Tin dioxide.....	0.0444%
Grains per pound.....	3.11
Equivalent to stannous chloride.....	3.91
Minimum doses.....	56.
Maximum doses.....	7.

Can eroded.

*Serial No. 565.*—Sample of canned pumpkin, bought of T. B. Vaure, July 11, 1890. Labeled: Belpre Pumpkin, Golden. George Dana & Sons, Belpre, Ohio.

Tin dioxide.....	0.0054%
Grains per pound.....	0.38
Equivalent to stannous chloride.....	0.48
Minimum doses.....	7.7
Maximum doses.....	1.0

Can eroded.

*Serial No. 566.*—Sample of canned Hubbard Squash, bought of T. B. Vaure, July 11, 1890. Labeled: Ladd Brand, L. Ladd, Adrian, Michigan.

Tin dioxide.....	0.026%
Grains per pound.....	1.85
Equivalent to stannous chloride.....	2.33
Minimum doses.....	37.00
Maximum doses.....	4.7

Can badly eroded.

*Serial No. 567.*—Sample of canned tomatoes, bought of T. B. Vaure, July 11, 1890. Labeled: Extra Fine Tomatoes. Blue Label. Curtice Bros. Co., Rochester, N. Y.

Tin dioxide.....	0.012%
Grains per pound.....	0.84
Equivalent to stannous chloride.....	1.06
Minimum doses.....	16.00
Maximum doses.....	2.00

Inner coating eroded.

*Serial No. 568.*—Sample of canned tomatoes, bought of T. B. Vaure, July 11, 1890. Labeled: Fresh Tomatoes, Curtice Bros Co., Rochester, N. Y.

Tin dioxide.....	0.014%
Grains per pound.....	0.98
Equivalent to stannous chloride.....	1.23
Minimum doses.....	19.00
Maximum doses.....	2.5

Can eroded.

*Serial No. 569.*—Sample of canned peas, bought of T. B. Vaure, July 11, 1890. Labeled : Petites Pois, P. Emillien, Bordeaux.

Copper oxide.....	0.0294%
Grains per pound.....	2.06
Equivalent to copper sulphate.....	3.95
Tin dioxide.....	0.0068
Grains per pound.....	0.48
Equivalent to stannous chloride.....	.60
Minimum doses.....	9.6
Maximum doses.....	1.2

No visible erosion.

*Serial No. 570.*—Sample of canned mushroom, bought of T. B. Vaure, July 11, 1890. Labeled : Champignons de Choix. Boston fils. Paris.

Tin dioxide.....	0.020%
Grains per pound.....	1.40
Equivalent to stannous chloride.....	1.76
Minimum doses.....	28.
Maximum doses.....	3.5

Inner coating highly discolored.

*Serial No. 571.*—Sample of canned blackberries, bought of T. B. Vaure, July 11, 1890. Labeled : Lawton Blackberries. Cur-tice Bros. Co., Rochester, N. Y.

Tin dioxide.....	0.0114%
Grains per pound.....	0.80
Equivalent to stannous chloride.....	1.01
Minimum doses.....	16.
Maximum doses.....	2.

Inner coating eroded.

*Serial No. 572.*—Sample of canned blueberries, bought of T. B. Vaure, July 11, 1890. Labeled: Blueberries. Eagle Brand, packed by A. & R. Loggie, Black Brook, N. B.

Tin dioxide.....	0.03%
Grains per pound.....	2.10
Equivalent to stannous chloride.....	2.64
Minimum doses.....	42.00
Maximum doses.....	5.3

Can badly eroded.

*Serial No. 574.*—Sample of canned salmon, bought of T. B. Vaure, July 11, 1890. Labeled: Best Fresh Columbia River Salmon, Eagle Canning Co., Astoria Clatsop Co., Oregon.

Tin dioxide.....	0.0134%
Grains per pound.....	0.94
Equivalent to stannous chloride.....	1.18
Minimum doses.....	18.9
Maximum doses.....	2.3

Inner coating eroded.

*Serial No. 578.*—Sample of canned pears, received of Mr. Edward Bethel, July 29, 1890. Labeled: Bartlett Pears. Solan's Brand, Packed in Solano Co., California.

	Juice.	Fruit.
Tin dioxide.....	0.0074%	0.0074%
Grains per pound.....	0.518	0.518
Equivalent to stannous chloride....	0.65	0.65
Minimum doses.....	10.4	10.4
Maximum doses.....	1.3	1.3

Can eroded.

*Serial No. 579.*—Sample of canned peaches, received of Edward Bethel, July 29, 1890. Labeled: Peaches, Wm. Maxwell, Baltimore, U. S. A.

	Juice.	Fruit.
Tin dioxide.....	0.0324%	0.0414%
Grains per pound.....	2.268	2.898
Equivalent to stannous chloride....	2.85	3.65
Minimum doses.....	45.6	58.4
Maximum doses.....	5.7	7.3

Can badly eroded.

*Serial No. 580.*—Sample of canned blackberries, received of Edward Bethel, July 29, 1890. Labeled : Blackberries, Clipper Brand, Wm. Munson & Sons, Baltimore, Md.

Tin dioxide.....	0.060%
Grains per pound.....	4.20
Equivalent to stannous chloride.....	5.28
Minimum doses.....	84.0
Maximum doses.....	10.6

Can badly eroded.

*Serial No. 581.*—Sample of canned cherries, received of Edward Bethel, July 29, 1890. Labeled : Red Cherries, Cloverdale Brand, G. C. Mournaw & Co., Cloverdale, Va.

Tin dioxide.....	0.0414%
Grains per pound.....	2.898
Equivalent to stannous chloride.....	3.65
Minimum doses.....	58.4
Maximum doses.....	7.3

Can badly eroded.

*Serial No. 582.*—Sample of canned pumpkin, received of Edward Bethel, July 29, 1890. Labeled : Royal Pumpkin, Urbana Canning Co., Urbana, Ohio.

Tin dioxide.....	0.0184%
Grains per pound.....	1.299
Equivalent to stannous chloride.....	1.62
Minimum doses.....	25.9
Maximum doses.....	3.2

Can eroded.

*Serial No. 583.*—Sample of canned baked sweet potatoes, received of Edward Bethel, July 29, 1890. Labeled : Tennessee Baked Sweet Potatoes, Capital Canning Co., Nashville, Tenn.

Tin dioxide.....	0.0132%
Grains per pound.....	0.92
Equivalent to stannous chloride.....	1.16
Minimum doses.....	18.5
Maximum doses.....	2.3

Can eroded.

*Serial No. 584.*—Sample of canned peas, received of Edward Bethel, July 29, 1890. Labeled: Marrowfat Peas, Parson Bros., Aberdeen, Maryland.

Tin dioxide.....	0.0044%
Grains per pound.....	0.30
Equivalent to stannous chloride.....	0.38
Minimum doses.....	6.2
Maximum doses.....	0.8
Can slightly eroded.	

*Serial No. 585.*—Sample of string beans, received of Edward Bethel, July 29, 1890. Labeled: String Beans. Packed by H. P. Hemingway & Co., Baltimore City, Md.

Tin dioxide.....	0.0154%
Grains per pound.....	1.08
Equivalent to stannous chloride.....	1.36
Minimum doses.....	21.7
Maximum doses.....	2.7
Can eroded.	

*Serial No. 586.*—Sample of canned salmon, received of Edward Bethel, July 29, 1890. Labeled: Puget Sound Fresh Salmon, Puget Sound Salmon Co., W. T.

Tin dioxide.....	0.0044%
Grains per pound.....	0.30
Equivalent to stannous chloride.....	0.38
Minimum doses.....	6.20
Maximum doses.....	0.8
Can slightly eroded.	

*Serial No. 587.*—Sample of condensed milk, received of Edward Bethel, July 29, 1890. Labeled: Borden's Condensed Milk. The Gail Borden Eagle Brand, New York Condensed Milk Co., 71 Hudson street, New York:

Tin dioxide.....	none.
No visible erosion.	

*Serial No. 592.*—Sample of canned pineapples, bought of Mr. Brown, Fifth avenue, August 4, 1890. Labeled: Pineapples, First Quality. Packed by Martin Wagner & Co., Baltimore, Md.

Tin dioxide .....	0.0098%
Grains per pound .....	0.686
Equivalent to stannous chloride .....	0.864
Minimum doses .....	13.6
Maximum doses .....	1.7

Can eroded.

*Serial No. 593.*—Sample of canned pineapples, bought of Mr. Brown, Fifth avenue, August 4, 1890. Labeled: Florida Pineapple, Oval Brand. Extra Quality. A. Booth Packing Co., Baltimore, Md.

Tin dioxide .....	0.0158%
Grains per pound .....	1.11
Equivalent to stannous chloride .....	1.4
Minimum doses .....	22.4
Maximum doses .....	2.8

Can eroded.

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## A NEW FORM OF VOLTAMETER.

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BY DR. G. C. CALDWELL.

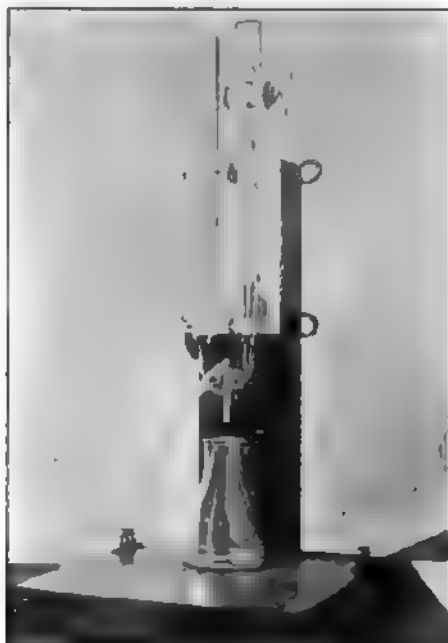
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In the recent development of electrolytic analysis it has come to be shown that a more careful adjustment of the strength of the current is essential, and that for much of the work very weak currents, evolving even as little as 0.1 or 0.2 c.c. of oxy-hydrogen gas per minute must be used for the best results; and it is not often, for any practicable determinations, that a current yielding over 10 c.c. per minute is required.

Therefore a voltameter that will readily show in its upper part tenths of a cubic centimeter is essential, and with a total capacity of 10 c.c. in its measuring tube is quite large enough, while in the measurement of the stronger currents the accurate reading to tenths is not important.

Classen's voltameter is familiar to those who make much use of electrolytic analysis. With its capacity of 30 c.c. it is unnecessarily cumbersome; and it is practically impossible to prevent slow leakage of the acid liquid when the rubber tube connects with the glass tubes. Other voltameters figured or described in the apparatus lists are now no more convenient.

For my own use I have devised the arrangement, made for me by Greiner, shown in the figure. It needs little explanation.



The lower stop cock is three-way, so that the two tubes can be connected with one another, or each or both with the outflow jet,

at pleasure. The distance from the lower to the upper stop cock is 21 cm., the diameter of the wider part of the graduated tube about 16 mm., the length of the narrow part, especially for measuring tenths, is 4 cm., and, as shown, this holds about 2 c.c.

The instrument is conveniently supported on a wooden stand, and held in place by two pieces of D violin strings, each piece having a loop at one end that passes over the head of a small screw in the side of the post, then through a small screw eye in front, then through a small hole in the shank of a larger screw eye in the other side of the post; by holding the end of the string cautiously near the lamp flame, it will swell sufficiently so that it cannot slip out through the hole again; then by turning the screw eye, a very little tightening of the string holds the instrument firmly in place.

Ordinary binding posts on the base of the stand can, of course, be used instead of the screw clamps; but with the wires from the electrodes soldered to these clamps, they serve the purpose well.

The acid electrolyte will leak even around a vaselined glass stopper, in time. But it is not at all essential to have an outflow at the bottom, especially if the reservoir tube is made somewhat wider than the other. The diminution of the volume of the gas under the pressure of the longer column of liquid in the reservoir tube is too small to be of account in this work. Even in my own instrument, with a reservoir tube only 17 mm. wide, when 2 c.c. have been collected, the change in volume by allowing the excess of liquid in the reservoir tube to flow out is inappreciable; when the level in the graduated tube has fallen to the mark for 9 c.c. and the reservoir tube is full to the top, the increase in volume is but 0.2 c.c. when both levels are brought to the same height. Without the three-way, outflow stop cock the instrument would, of course, be much cheaper and practically quite as serviceable.

CORNELL UNIVERSITY, July, 1891.



## IDENTIFICATION OF ARSENIC AND ANTIMONY.

BY JAMES T. ANDERSON.

The method of separating arsenic and antimony by passing  $H_2S$  and then dry  $HCl$  gas through the tubes in which the metals have been deposited as in Marsh's test, has been modified by the writer so as to be conveniently applied in cases where it is desired to identify as arsenic or antimony metallic deposits on porcelain.

Add a drop of ammonium sulphide to the deposit, which converts the metal into the sulphide. Allow the excess of ammonium sulphide to evaporate, and with an ordinary mouth blow-pipe blow across the open mouth of a bottle containing concentrated  $HCl$ , directing the stream of gas into the porcelain dish upon the sulphide. If it be antimony sulphide, it will disappear entirely, while arsenic sulphide will remain unaffected in appearance.

AGR. & MECH. COLLEGE, Auburn, Ala., July 27, 1891.

## ON METATITANIC ACID AND THE ESTIMATION OF TITANIUM BY HYDROGEN PEROXIDE.

BY PROF. F. P. DUNNINGTON.

The detection and estimation of small amounts of titanic acid which has long been very tedious and unsatisfactory, has been rendered exceedingly simple through the publication of A. Weller in the *Ber. d. Chem. Ges.*, 1882, of a method depending upon the production of a compound of intense yellow color by the addition of hydrogen peroxide to the solution of titanium.

Since its publication I have made considerable use of this method, but have recently noted a feature in the test which must be kept in view to avoid error. The solution of the melt obtained by fusion with acid sodium sulphate when made with dilute sulphuric acid of five or more per cent., gives constant results, which tally with those made gravimetrically; but when water only or very dilute acid is employed, one may obtain lower results. Upon one occasion a coloration was obtained which corresponded to only about one-third of the titanium, which was afterwards found to

be present. Moreover, if we take a slightly acid solution of titanium sulphate, dilute it and heat until it is partially precipitated, cool, redissolve with sulphuric acid and then add hydrogen peroxide, the yellow coloration will correspond to only a portion of the titanium present. I find an explanation of these facts in the formation of some meta-titanic acid. It is uniformly stated that when titanous acid is precipitated by heating a not too acid solution, it separates in the form of meta-titanic acid.

In order to further examine the metatitanic acid which was in part described by Weber (*Jahr.*, 1863, p. 210), I have isolated it as follows: Heat a dilute solution of titanium sulphate to 100° C.; gradually add ammonia to excess, filter, treat the washed precipitate with hydrochloric acid and warm; there results a residue which is nearly insoluble in strong hydrochloric acid. Now wash this once or twice by decantation with cold water, and, when most of the hydrochloric acid is removed, there will be left a mass perfectly and readily soluble in cold water.

Again, if the above precipitate is treated with hydrochloric acid, and then evaporated upon the water bath to remove the latter acid, there is left a mass of scales of a gummy appearance, which dissolves in a moderate amount of water, giving an opaline solution. This substance is practically free from chlorine and contains one molecule of water to one of titanous acid—and so presents the composition of the air dried metatitanic acid of Merz. If either of these water solutions of meta-titanic acid be treated with hydrogen peroxide, it will not be colored yellow, but afford a white precipitate.

It therefore appears probable that after the fusion of titanous oxide with acid sodium sulphate, if the melt is digested in water only, the solution of the free acid may occasion sufficient heat to form some metatitanic acid, which when redissolved by the further admixture of acid would not be colored by the hydrogen dioxide.

And we conclude that in making the estimation of titanium by the method of A. Weller, the "melt," after cooling, is to be digested in dilute sulphuric acid of such strength as will prevent the formation of a precipitate even in warm solutions of titanous sulphate; for this purpose 5 per cent. acid is found to answer.

UNIVERSITY OF VIRGINIA, August, 1891.

# AN ERROR IN THE PRESENT OFFICIAL METHOD FOR THE DETERMINATION OF ALBUMINOID NITROGEN, AND THE EFFECT OF THE PRESENCE OF METALS PRECIPITABLE BY POTASSIUM SULPHIDE IN THE DETERMINATION OF NITROGEN BY KJELDAHL'S METHOD.\*

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BY HARRY SNYDER.

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In the determination of nitrogen by the Kjeldahl method directions are given for the addition of potassium sulphide to precipitate *all* mercury from the solution in order to prevent the formation of mercurio-ammonium compounds which are not completely decomposed by soda solution.

The determination of albuminoid nitrogen according to the present official method, requires the use of 0.7 to 0.8 grm. of copper hydroxide previous to the determination of the nitrogen by the Kjeldahl method.

The copper oxide is carried along in the determination, and is freely soluble in the sulphuric acid; no provision is made for its removal, and when the potassium sulphide is "added to precipitate *all* mercury in solution," copper sulphide is alike precipitable in the acid solution with the mercury. The copper present is more than enough to combine with all the potassium sulphide; the result is that neither metal is completely precipitated, and a large and variable portion of the mercury is left in the solution and all the conditions are favorable for the formation of mercurio-ammonium compounds. The work given to the potassium sulphide is doubled and the object for which it is added is not attained.

In order to determine to what extent the mercury so left in the solution would effect the results a number of determinations were started; to some the official "20 c.c. of potassium sulphide" were added, and to others a sufficient quantity of the same solution to

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\* Presented to the A. A. O. A. C., at their annual meeting held in Washington, August, 1891, and read by Prof. Caldwell, President of the Association.

precipitate *all* the copper as well as *all* mercury in solution. The large amount of precipitate formed in the latter case caused so much bumping that only one determination out of six could be completed.

In order to obviate this difficulty the operation was carried on exactly as required by the official method except that previous to distillation the acid solution was made up to 200 c.c. and divided into two 100 c.c. portions. One portion was distilled with the relative official amount of potassium sulphide, and the second with enough of the same solution to complete the reaction. This gives a more satisfactory basis for the comparison of results, since all the conditions previous to the distillation are the same as to the degree of oxidation and the amounts of mercury and copper in solution.

The following results were obtained :

	50 c.c. K <sub>2</sub> S	30 c.c. K <sub>2</sub> S.	Difference.
Ensilage No 1 . . . . .	1.28 per cent.	1.12 per cent.	0.16 per cent.
	1.25    “	1.14    “	0.11    “
No. 2 . . . . .	0.66    “	1.53    “	0.13    “
	0.66    “	1.60    “	0.06    “
No. 3 . . . . .	1.36    “	1.27    “	0.09    “
	1.20    “	1.15    “	0.05    “
No. 4 . . . . .	1.52    “	1.45    “	0.07    “
	1.54    “	1.45    “	0.09    “
No. 5 . . . . .	1.18    “	1.08    “	0.10    “
	1.23    “	1.12    “	0.11    “
Average . . . . .			0.096

Since all the conditions previous to distillation and addition of the potassium sulphide were the same in each portion as to the degree of oxidation, and amounts of mercury and copper in solution the constant larger proportion of nitrogen yielded with the 50 c.c. of potassium sulphide must be due to the incomplete precipitation of all the mercury in solution when only 20 c.c. is added. The average difference in the ten portions amount to nearly a tenth of one per cent.

Blank determinations with both 20 and 50 c.c. portions of potassium sulphide showed no quantity of nitrogen. A difference of

## 214 DETERMINATION OF NITROGEN BY KJELDAHL'S METHOD.

a tenth of one per cent. of nitrogen when multiplied by the protein factor would make a difference of over six-tenths of one per cent. of protein, a difference which is too great to be overlooked.

Some change must therefore be made in combining Stutzir's and Kjeldahl's methods. The following proportions of substance and solutions will give satisfactory results. Start with 7 gms. of substance instead of 1 gram, take a quantity of copper hydroxide and glycerine solution equivalent to .5 to .6 grams of the hydroxide instead of .7 to .8, and finally use 30 c.c. of potassium sulphide instead of 20. Trials with these proportions on the committee sample of corn meal gave 1.56 per cent. and 1.55 per cent. of albuminoid nitrogen with the old proportions, with all of the copper and mercury precipitated, 1.56 per cent. of albuminoid nitrogen. (1)

In the determination of nitrates by the official method 2 grams of zinc dust are used but the previous addition of 2 grams of salicylic acid converts the zinc into an insoluble and crystalline form at the close of the digestion. This is shown to be true by the following results of the analysis of pure potassium nitrate, when the solution was divided as in the case of the determination of albuminoid nitrogen.

	20 c.c. $K_2S$	40 c.c. $K_2S$
1. Nitrogen	14.02 per cent.	14.02 per cent.
2. " "	13.98	13.98

If in the above tests the salicylic acid is omitted the results obtained are not uniform, and fall short of the actual amount of nitrogen present. This is due to the presence of the zinc in solution, which causes the same trouble as the copper. Any other metal precipitable by potassium sulphide would be equally liable to produce the same effect, as all of the conditions would be equally favorable for the formation of mercurio-ammonium compounds.

CORNELL UNIV., Lab. of Agr. Expt. Station.

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(1) These changes as given above have been adopted in the official method.

## RAPHIDES, THE CAUSE OF THE ACRIDITY OF CERTAIN PLANTS.

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BY R. A. WEBER, PH. D.

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At the last meeting of the American Association for the Advancement of Science, Prof. W. R. Lazenby reported his studies on the occurrence of crystals in plants. In this report he expressed the opinion that the acidity of the Indian turnip was due to the presence of these crystals or raphides. This opinion was opposed by Prof. Burrill and other eminent botanists, who claimed that other plants, as the fuchsia, are not at all acrid, although they contain raphides as plentifully as the Indian turnip. Here the matter was allowed to rest.

The U. S. Dispensatory and other works on pharmacy ascribe the acidity of the Indian turnip to an acrid, extremely volatile principle insoluble in water and alcohol, but soluble in ether. Heating and drying the bulbs dissipate the volatile principle, and the acidity is destroyed.

At a recent meeting of Ohio State Microscopical Society this subject was again brought up for discussion. It was thought by some that the raphides in the different plants might vary in chemical composition, and thus the difference in their action be accounted for. This question the writer volunteered to answer.

Accordingly, four plants containing raphides were selected, two of which, the *Calla cassia* and Indian turnip, were highly acrid, and two, the *Fuchsia* and *Tradescantia*, or Wandering Jew, were perfectly bland to the taste.

A portion of each plant was crushed in a mortar, water or dilute alcohol was added, the mixture was stirred thoroughly and thrown upon a fine sieve. By repeated washing with water and decanting a sufficient amount of the crystals was obtained for examination. From the calla the crystals were readily secured by this

means in a comparatively pure state. In the case of the Indian turnip the crystals were contaminated with starch, while the crystals from the fuchsia and tradescantia were imbedded in an insoluble mucilage from which it was found impossible to separate them. The crystals were all found to be calcium oxalate.

Having determined the identity in chemical composition of the crystals, it was thought that there might be a difference of form of the crystals in the various plants, from the fact that calcium oxalate crystalizes both in the tetragonal and the monoclinic systems. A laborious microscopic examination, however, showed that this theory also had to be abandoned. The fuchsia and tradescantia contained bundles of raphides of the same form and equally as fine as those of the acrid plants. At this point in the investigation the writer was inclined to the opinion that the acidity of the Indian turnip and calla was due to the presence of an acrid principle.

Since the works on pharmacy claimed that the active principle of the Indian turnip was soluble in ether, the investigation was continued in this direction. A large stem of the calla was cut into slices, and the juice expressed by means of a tincture press. The expressed juice was limpid and filled with raphides. A portion of the juice was placed into a cylinder and violently shaken with an equal volume of ether. When the ether had separated a drop was placed upon the tongue. As soon as the effects of the ether had passed away, the same painful acidity was experienced as is produced when the plant itself is tasted. This experiment seemed to corroborate the assumption of an acrid principle soluble in ether. The supernatant ether, however, was slightly turbid in appearance, a fact which was at first ignored. Wishing to learn the cause of this turbidity a drop of the ether was allowed to evaporate on a glass slide. Under the microscope the slide was found to be covered with a mass of raphides. A portion of the ether was run through a Munktell filter. The filtered ether was clear, entirely free from raphides, and had also lost every trace of its acidity.

The same operations were repeated upon the Indian turnip with exactly similar results.

These experiments show conclusively, that the acridity of the Indian turnip and calla is due to the raphides of calcium oxalate only.

The question of the absence of acridity in the other two plants still remained to be settled. For this purpose some recent twigs and leaves of the fuchsia were subjected to pressure in a tincture press. The expressed juice was not limpid, but thick, mucilagenous and ropy. Under the microscope the raphides seemed as plentiful as in the case of the two acrid plants. When diluted with water and shaken with ether, there was no visible turbidity in the supernatant ether, and when a drop of the ether was allowed to evaporate on a glass slide, only a few isolated crystals could be seen. From this it will be seen that in this case the raphides did not separate from the mucilagenous juice to be held in suspension in the ether. A great deal of time and labor were spent in endeavouring to separate the crystals completely from this insoluble mucilage but without avail. With the *tradescantia* similar results were obtained.

From these experiments the absence of acridity in these two plants, in spite of the abundance of raphides, may readily be explained by the fact, that the minute crystals are surrounded with and embedded in an insoluble mucilage, which prevents their free movement into the tongue and surface of the mouth, when portions of the plants are tasted.

The reason why the Indian turnip loses its acridity on being heated, can be explained by the production of starch paste from the abundance of starch present in the bulbs. This starch paste would evidently act in a manner similar to the insoluble mucilage of the other two plants.

So also it can readily be seen that when the bulbs of the Indian turnip have been dried, the crystals can no longer separate from the hard mass which surrounds them, and consequently can exert no irritant action when the dried bulbs are placed against the tongue.



## Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

July 7, 1891.

**455,308.**—Apparatus for defecating and evaporating saccharine juices. Ramon F. Cordero, Rubio, Venezuela.

**455,376.**—Manufacture of cement. Herbert H. Wing, Buffalo, N. Y.  
A mixture of a phosphate and silicate is calcined, the resulting product forming hydraulic cement.

**455,420.**—Method of electric welding. Elihu Thompson, Swampscott, Mass.

**455,442.**—Betadeltaamidonaphthol. Jacob Schmid, Basle, Switzerland.  
This new product is derived from the sodium salt of beta-naphthyl-aminedeltamonosulpho acid, melting at about 200°C, crystallizing from alcohol in small white needles, scarcely soluble in water, more so in benzene, easily soluble in ether and alcohol.

**455,458.**—Process of and apparatus for the reduction of ore. Charles J. Eames, New York, N. Y.

**455,471.**—Condensing apparatus. John Caven, Indianapolis, Ind.

**455,491.**—Cooling apparatus for calcined material. Amable B. Bonnevill, Allentown, Pa.

**455,529.**—Process of coating wire with other metal. John Coffin, Johnstown, Pa.

**455,531.**—Ore separator. Edward G. Good and James Thorne, Portland, Ore.

**455,580.**—Treatment and preparation of gypsum. Frederick G. H. Rothe, Berlin, Ger.

**455,611.**—Process of reducing kaolins and clays to their component oxides. Philip A. Emanuel, Aiken, S. C.

The clay is treated with sulphuric acid and heated for the conversion of the alumina into aluminium sulphate. This sulphate is then separated from the silica, and heated with sulphur.

**455,631.**—Apparatus for the defecation of saccharine juices by electricity in the manufacture of sugar. Elias Maigrot and José Sabates, Havana, Cuba.

**455,654.**—Ore washer. James O. Campbell, Colton, Utah.

**455,674.**—Process of treating hides. George C. Walter, Hastings, Mich.

**455,675.**—Purification and manufacture of sugar. Moriz Weinrich, St. Louis, Mo.

**455,693.**—Galvanic battery. Henry C. Sample, Ravenswood, Ill.

*July 14, 1891.*

**455,768.**—Manufacture of tartaric acid. Robert W. Shedler, Brooklyn, N. Y.

Solutions of tartaric acid concentrated to the point of crystallization are subjected to an addition of sulphuric acid whereby the quantity of crystallized tartaric acid as the result of the first crystallization is increased. The mother liquor is then used for the further treatment of calcium tartrate and thus a second charge of tartaric acid is obtained in solution.

**455,802.**—Apparatus for the treatment of city refuse. John C. Stanley and Joseph Russell, London, Eng.

**455,808.** } —Electro-magnetic ore separator. Jonas Wenström, Örebro,  
**455,809.** } Sweden.

**455,952.**—Brown dyestuff. Christopher Ris, Basle, Switzerland.

A brown dye derived from a mixture of paranitro-tolnol sulpho-acid with paraphenylendiamine in a solution of caustic alkalies. The dye is soluble in water and alcohol.

**456,047.**—Process of producing surprise pictures. Otto Meyer, New York, N. Y.

Drawings are made upon suitable material with solutions of phenolphthalein, ceroline, or any other indicator of alkaline reaction, and subsequently subjecting the same to the reaction of an alkali to develop the lines, words or figures.

**456,081.**—Red dyestuff. Maurice Ceresole, Neuville, France.

The new dye base, symmetrical diethylrhodamine, derived from monoethylmetaamidophenol and phthalic anhydride, is a bluish red, crystalline powder, slightly soluble in water, alcohol, ether, and benzine, readily soluble in wood spirit with greenish fluorescence, forming a basic hydrochloride readily soluble in alcohol with intense green yellow fluorescence, soluble in strong hydrochloric and sulphuric acids, and slightly soluble in water with subsequent decomposition and separation of the base.

*July 21, 1891.*

**456,140.**—Apparatus for the manufacture of coal gas. James Elliott, Ludlow, Eng.

**456,172.**—Method of measuring electric currents. Elihu Thompson, Lynn, Mass.

The method consists in generating heat by the electric current, evaporating a liquid by the heat so generated and from the amount of evaporation ascertaining the amount of current.

**456,188.**—Process of obtaining iodine. Hubert H. Wing, Buffalo, N. Y.

The mother liquor from the purification of sodium nitrate is mixed with silicious material and the mixture is calcined. The sublimed iodine is collected in suitable chambers.

**456,204.**—Manufacture of galvanized iron. Joseph W. Richards, Philadelphia, Pa.

Metallic aluminium is diffused throughout a bath of metallic zinc and the metallic iron then dipped into this bath.

**456,241.**—Process of treating cocoanut husks. John T. Davis, San Francisco, Cal.

The husks are first digested in an alkaline solution under heat and then subjected to the action of crushing rollers, etc.

**456,294.**—Manufacture of soda-alum. Francis M. Spence and David D. Spence, Manchester, Eng.

**456,297.**—Plastering composition. Aaron Anthony, Springfield, Ill.

**456,311.**—Flux for smelting or reducing ores. Thomas Miller, Salt Lake City, Utah.

**456,314.**—Manufacture of plated stock for jewelry. John S. Palmer Providence, R. I.

**456,323.**—Ore leaching machine. Pierre L. Gibbs, Clinton, Iowa.

**456,481.**—Manufacture of glucose or sugar. Julius Dubiel, Waukegan, Ill.

**456,499.**—Apparatus for evaporating liquids containing salt. Sigismund Pick, Szczakowa, Austria-Hungary.

**456,508.**—Celluloidal explosive and process of making the same. Alfred Nobel, Paris, France.

A dense, horny, granular substance, solid at ordinary temperature, and composed of nitro-cellulose, nitro-glycerine and suitable oxidants.

**456,516.**—Process of treating copper matte. Pierre Mannes, Lyons, France.

**456,517.**—Ore-roasting furnace. Patrick Marley, Idaho City, Idaho.

**456,540.**—Method of welding by electricity. John H. Bassler, Myerstown, Pa.

**456,541.**—Method of and apparatus for electric-welding. S. Lloyd Wygand, Philadelphia, Pa.

*July 28, 1891.*

**456,589.**—Method of preparing sterilized chocolate. Gustav H. Neuhauss, Johann F. H. Gronwald, and Emil Oehlmann, Berlin, Germany.

**456,606.**—Process of and apparatus for expressing oil and regulating the action of hydrostatic presses. John H. Vaile, Dayton, Ohio.

**456,622.**—Magnetic separator. David E. Lain, Yonkers, N. Y.

**456,627.**—Process of making azo dyes. Carl A. Martins, Berlin, Germany.

The process consists "in first forming an alpha-naphtholdisulphonic acid by treating naphthaline disulphonic acid with nitric acid, reducing the alpha-nitronaphthaline disulphonic acid and conveying said alpha-amidonaphthaline disulphonic acid into the corresponding compound alpha-

naphthol disulphonic acid ; secondly, forming a diazo derivative of an amido compound, such as xylidine, cumidine, alpha-naphthylamine, etc.; and, thirdly, adding the said alpha-naphthol disulphonic acid to the diazo compound so formed."

**456,629.**—Process of making azo dyes. Carl A. Martius, Berlin, Germany.

Process somewhat similar to the above except from second stage, when a tetrazo derivative of an amido compound is formed, such as diamidostilbene, benzidine, etc.; thirdly, adding to the solution of the tetrazo compound so formed the alpha-naphthol disulphonic acid in certain proportions to form a compound of one molecule of the tetrazo compound combined with one of the alpha-naphthol disulphonic acid; and, fourthly, adding to this compound a portion of naphthol or naphthol-sulphonic acid in the proportions about as stated; and, fifthly, precipitating the dye stuffs from the solution.

**456,659.**—Vulcanized paint. Luke W. Osborn, Joliet, Ill.

**456,668.**—Reverberatory furnace. William Stubblebine, Bethlehem, Pa.

**456,730.**—Machine for decorticating fibrous plants. John H. Lorimer, Philadelphia, Pa.

**456,772.**—Composition to be used as a varnish, lacquer, or glue. Thomas B. Osborne, New Haven, Conn.

Consists of zein, a resinous gum and mutual solvent thereof.

**456,773.**—Process of extracting zein. Thomas B. Osborne, New Haven, Conn.

The nitrogenous matter left after the manufacture of starch from corn is treated with a suitable solvent to extract the zein.

**456,791.**—Apparatus for making bisulphites. Norman H. Riopan, Kankauna, Wis.

**456,821.**—Process of waterproofing and preserving textures and other materials. Charles F. Hime and John H. Ward, London, Eng.

The fibrous materials are treated with a solution of cellulose and ammonia zinc.

**456,844.**—Gold chlorinating process. James H. Pollock, Glasgow, Scotland.

**456,852.**—Concentrator and amalgamater. Jacob Rodermond, New York, N. Y.

**456,872.**—Process of manufacturing malt. Frederick W. Wienbrock, New York, N. Y.

**456,890.**—Drying oil and method of making the same. Norval H. Finley, Rochester, Pa.

**456,897.**—Azo dye. Carl A. Martins, Berlin, Germany.

To a tetrazo derivative of diphenylidine add alpha-naphthol disulphonic acid (see Pat. 456,627) in certain proportions to form a compound of one

molecule of tetrazodiphenilidine with on<sup>o</sup> of the alpha-naphthol disulphonic acid, then adding to this compound another portion of the alpha-naphthol disulphonic acid, and then precipitating the dyestuff.

**456,903.**—Food compound. George F. Ordway, Boston, Mass.

A food candy consisting of a protein substance, fat, sugar, sodium phosphate, magnesium carbonate and flavoring materials.

**456,967.** } —Ore concentrator. Charles E. Seymour, Hurley, Wis.

**456,968.** }

**457,002.**—Process of making nitro-glycerine. Ebenezer K. Mitting, Chicago, Ill.

**457,028.**—Process of making chrome yellow. Frederick W. Ihne, Kansas City, Mo. Pulverized galena is treated with nitric acid to make lead nitrate and the solution is precipitated by a soluble chromate, etc.

**457,029.**—Process of treating tobacco leaves. William E. Johns, High Point, N. C.

**457,063.**—Apparatus for charging furnaces. George R. Ward, Munhall, Pa.

**457,097.**—Process of evaporating sirup. Lorin R. Tabor, Westford, Vt.

**457,145.**—Ore sampling machine. Henry L. Bridgman, Blue Island, Ill.

**457,205.**—Alloy and method of producing it. Henry Marbeau, Paris, France. A method of producing alloys of iron and steel with nickel.

**457,231.**—Method of manufacturing rock faced, artificial stone. Charles W. Stevens, Lansing, Mich.

**457,250.**—Furnace. Nicholas Brayer, Rochester, N. Y.

**457,256.**—Process of obtaining zinc sulphate from zinciferous ores. Charles E. Croselmire, Newark, N. J.

*August 11, 1891.*

**457,342.**—Anti-corrosive and anti-fouling compound. Max E. Dejonze, Stapleton, N. Y. A compound consisting of zinc dust six parts and paraffine one part by weight.

**457,465.**—Potting kiln. John McCloskie, Massillon, Ohio.

**457,471.**—Preserving apparatus. Leopold Bregher, Ober Döbling, near Vienna, Austria.

**457,487.**—Apparatus for the manufacture of gas. John H. W. Stringfellow, London, Eng.

**457,488.**—Process of dyeing. Alfred Fischhesser and Joseph Pokorny, Lutterbach, Germany. The improvement consists in alternately impregnating or coating the fiber or fabric with a diazotized amido substance and with betaoxynaphthoic acid, the melting point of which is 216° C.

**457,541.**—Apparatus for grinding and amalgamating ores. Frederick Stahl and John S. Rew, St. Armand, Victoria.

**457,589.**—Rotory furnace for burning cement, lime; etc. José F. de Navarro, New York, N. Y.

**457,712.**—Process of photographing. Israel H. Hamburger, New York, N. Y. A process for producing a photographic picture in relief upon the surface of a sheet or block of zylonite or other pyroxyline material. "A sheet of the material is coated with a solution of albumen acidulated with acetic acid, applying to this surface a paper sensitized in any suitable manner and having a pigment or dye mingled with the sensitized coating, the latter containing an undeveloped photographic image or picture, immersing the coated surface with the paper applied in cold water, pressing the paper closely upon said surface, then immersing the same with the paper in contact in warm water, removing the paper and the soluble parts of the sensitized coating, hardening the insoluble adhering parts by immersion in cold water, fixing the picture by immersion in a strong solution of alum and drying."

*August 18, 1891.*

**457,799.**—Method of producing Alcohol. Alfred Springer, Cincinnati, Ohio. Grain or farinaceous material is treated with dilute nitric acid for the conversion of the starch into dextrose, and the mash afterward fermented while wholly or partially retaining the acid, then neutralizing and distilling the mash.

**457,803.**—Carburetor. Oliver Vanorman, Los Angeles, Cal.

**457,817.**—Method of preparing photographic plates. Oswald Moh, Görlitz, Germany.

A plate of moscovite or mica, "previously submitted to a treatment by a solution of chromic alum and gelatin for removing the mineral grease, from the natural mica and enabling the same to receive in fixed and solid adherence a sensitive coating."

**457,821.**—Enameling oven or kiln. David O. Paige, Detroit, Mich.

**457,831.**—Soda motor. Robert R. Zell, Baltimore, Md.

**457,832.**—Method of operating motors. Robert R. Zell, Baltimore, Md.

**457,863.**—Process of making isoeugenol. George de Laire, Paris, France.

Eugenol or essence of cloves is heated with potassium hydrate and alcohol until a reaction is effected, the alcohol is then expelled with steam and the mass is treated with acid to separate the isoeugenol.

**457,864.**—Process of making compounds of isvengenol. George de Laire, Paris, France.

**457,914.**—Soap making apparatus. William A. Grant, Houston, Tex.

**457,917.**—Apparatus for purifying water. Thomas Shaw, Philadelphia, Pa.

**457,953.**—Composition for artificial stone. Edward Gallagher, Lock Haven, Pa.

Consists of cement sand, plaster of paris, powdered soapstone and salt mixed in a dry state and then rendered plastic by the admixture of lime-water.

**458,020.**—Indelible print or picture. Joseph R. France, New York, N. Y.

**458,075.**—Oil filter. Thomas W. Shelton, Cleveland, Ohio.

**458,102.**—Furnace for calcining ores. James Douglas, New York, N. Y.

**458,132.**—Process of impregnating leather. George C. Seeberger, Munchberg, Germany.

The leather is first impregnated with an oil, the latter then partially oxidized and finally the whole coated with a resinous varnish.

**458,134.**—Chemical fire extinguisher. Ernest F. Steck, Chicago, Ill.

**458,135.**—Process of making paper stock. John D. Tompkins, Nassau, N. Y.

*Aug. 25, 1891.*

**458,157.**—Composition of matter for use as a substitute for glass, etc. Freiderich Eckstein, Vienna, Austria-Hungary.

A composition of matter consisting of collodion wool, a non-resinous oil, a castor oil, and a balsam or soft rosin.

**458,174.**—Apparatus for pneumatic malting. Johannes Küntze, Nordhausen, Germany.

**458,193.**—Milk testing apparatus. David T. Sharples, Elgin, Ill.

**458,194.**—Centrifugal milk testing apparatus. David T. Sharples, Elgin, Ill.

**458,244.**—Litmus pencil. Josiah S. Tyree, Washington, D. C.

**458,281.**—Induline dye. Benno Homolko, Höchst-on-the-Main, Germany.

Process of heating a mixture of soluble indulines together with paraphenylenediamine and hydrochlorate of paraphenyldiamine, and, after filtering, precipitating by means of common salt and zinc chloride. The process yields a blue coloring matter of the induline series, a zinc chloride double salt in form of a brown powder with metallic lustre, insoluble in ether, benzole and chloroform, somewhat soluble in alcohol, of very easy solubility in water, showing violet blue coloration, nearly insoluble in hydrochloric acid, but soluble in cold sulphuric acid, and precipitated by alkalies and oxidizing agents from aqueous solutions.

**458,283.**—Azo dye. Hans Kuzel, Höchst-on-the-Main, Germany.

Process for producing an azo coloring matter by diazotizing 93 parts of aniline with 267.7 parts of hydrochloric acid thirty per cent., and 69 parts of sodium nitrite (all by weight), at a temperature between 0° and

5° C. and, while stirring, introducing it into a paste made from 404 parts of the disodium salt of naphthaline disulphonic acid and 340 parts of sodium acetate (all parts by weight) and finally precipitating the color by means of common salt, filtering, and drying it.

The coloring matter is a brown powder easily soluble in cold water and dilute acids, freely soluble in hot alcohol of 75° Tralles, insoluble in ether and ligroine, and adapted for dyeing wool in greatly differing shades, ranging from bluish red to deep black, depending upon the use of acids or the latter in combination with metallic mordants.

**458,284.**—Azo dye. Hans Kuzel, Höchst-on-the-Main, Germany.

A dark reddish brown powder derived from naphthol trisulphonic acid-monamide and diazo bodies.

**458,285.**—Amido-naphthol monosulphonic acid. Hans Kuzel, Höchst-on-the-Main, Germany.

Method consists in melting the salts of beta-naphthylamine disulphonic acid with caustic alkalies. The amido-naphthol monosulphonic acid is a crystalline powder of difficult solubility in water and of less solubility in alcohol of 60° Tralles, insoluble in absolute alcohol, ether, and ligroine. The solution of the acid or its salts show violet blue fluorescence, with Fe, Cl, solution a dirty red coloration, and with chloride of lime a dark red brown coloration, which, on the addition of an excess disappears gradually, and the diazo compound is yellow.

**458,286.**—Amido-oxynaphthaline disulphonic acid. Hans Kuzel, Höchst-on-the-Main.

Long pearly needles slightly soluble in alcohol, ligroine and ether, easily soluble in water with violet fluorescence, turning green by the addition of alkali, brown by ferric chloride and bleaching powder, but decolorized by an excess of the latter.

**458,419.**—Substitute for white of eggs. John E. Furber, Lawrence, Mass.

A powder composed of soluble vegetable or animal albumen, corn starch, dextrine, sodium bicarbonate, sodium chloride, sulphur and phosphates.

**458,420.**—Compound as a substitute for yolks of eggs. John E. Furber, Lawrence, Mass.

Similar to No. 458,419 but with addition of animal or vegetable oil.

**458,440.**—Ice making and refrigerating machine. William H. Appleton, New York, N. Y.

**458,502.**—Amalgamator. Thomas Shannon, Whitewood, S. D.

**458,534.**—Composition for water-proofing pulp and other fibrous articles. Frank E. Keyes, Lockport, N. Y.

A mixture of rosin, linseed oil, and cottonseed oil.

**458,551.**—Insulating compound. James L. Marmand, Malden, Mass.

J. F. G.





REGULAR MEETING, October 2, 1891.

The regular meeting of the Society was held in the Law Lecture Room of the University Building.

The President, Prof. G. F. Barker in the chair.

The minutes of the September meeting were read and accepted.

The minutes of the meeting of the Board of Directors, September 30th, were read.

The following members were elected :

Honorary member : Jean Servais Stas.

Members : Geo. E. Barton, Philip E. Chazal, Prof. F. W. Clarke, A. R. L. Dohme, Walter G. Graves, John A. Miller, Henry Pemberton, Jr., Mark Powers, A. L. Smith, Clarence L. Speyers, Prof. Harvey W. Wiley.

The following nominations for membership were made : Frank H. Andrews, Lyman C. Newell, Clarence E. Wilson, all of Providence, R. I.

A paper was read by Mr. J. F. Geisler, on "An Analysis of a Pe-koe Ceylon Tea."

Prof. McMurtrie moved that a committee on nominations for the December election be appointed.

Dr. H. Endemann presented the following :

"*Resolved*. That it is the sense of this meeting that the Committee on Papers and Publications have exceeded their powers in rejecting, on the grounds stated by their chairman, the paper by Dr. Endemann, entitled 'On Gluten,' and that the said paper be re-committed to them for further consideration and for report to the Society at the next regular meeting." Not carried.

Miscellaneous business being then in order, the Chair appointed the Committee on Nominations for the annual election of officers in December, as follows :

Prof. Wm. McMurtrie, Prof. A. B. Prescott, Prof. C. E. Munroe.

The following resolution was then offered :

*Resolved*, That it is the sense of the Society that there should be a general meeting held in the last week in December, and that the matter be referred to the Board of Directors. Carried.

The meeting was then adjourned.

DURAND WOODMAN,  
*Recording Secretary.*

## PINE TREE SUGAR.

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By HARVEY W. WILEY.

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Pine tree sugar is derived from an exudation from the *Pinus lambertiana*. The resin or sap of the tree collects in cavities made with an ax or by fire, and on drying forms masses of impure sugar. These crude samples have a very sweet taste and a somewhat peculiar one, due to the resin which they contain, but would at once be pronounced sugar from the taste alone.

*Pinus lambertiana* occurs in the Oregon Cascade and Coast ranges, from the head of the Mackenzie River and the valley of the Rogue River, south along the western flank of the California Sierras, through the Coast ranges to the Santa Lucia Mountains and in the San Bernardino and Cuyamaca Mountains. It is a large tree 46 to 92 metres high, 3 to 7 metres in diameter. It is most common and reaches its greatest development upon the Sierras of Central and Northern California, between 4,000 and 8,000 feet elevation. In Oregon it descends to 1,000 feet.

In 1887 some members of the Geological Survey collected a small quantity of this exudation from the sugar pines and this was sent to me by Mr. H. M. Wilson.\* The quantity of material was sufficient for a preliminary study, which showed that it was a sugar having a specific rotatory power of about 65, unacted on by Fehling solution either before or after treatment with hydrochloric acid, and possessing a composition which was represented approximately by the formula  $C_7H_{14}O_6$ .† In searching through the literature on this subject I found that pine tree sugar had been examined by Berthelot and described in "Annales de Chimie,"

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\*Received Feb. 6, 1888. Examined March, 1889.

†Means of three combustions. C=41.51%. H=7.47%.

3d series, Vol. 46, 1856, p. 76. Following is an abstract of Berthelot's paper :

"M. Boursier de la Riviere, consular agent of France in California, in 1856 took with him to France a saccharine substance produced by the *Pinus lambertiana*. This material was given to M. Berthelot for analysis. M. Boursier collected this substance from cavities near the base of trees. The exudation from the tree is at first resinous and semi-liquid. It gradually becomes dry and forms irregular masses, consisting mostly of sugar. The natives of the country eat it. Pure pinite is prepared by dissolving the crude sugar in water, filtering through animal boneblack, and leaving to spontaneous evaporation. Several weeks are required for the formation of the proper crystals. These were re-crystallized twice, and the pure pinite obtained subjected to analysis. The analysis gave the following percentages of carbon and hydrogen :

Carbon .....	43.4%
Hydrogen .....	7.8%

The second combustion gave :

Carbon .....	43.5%
Hydrogen .....	7.3%

These numbers led to the formula  $C_6 H_{12} O_5$  or  $C_{12} H_{24} O_{10}$  in which the percentages of carbon and hydrogen completed are as follows :

Carbon .....	43.9%
Hydrogen .....	7.2%

The combustion of pinite is very difficult. It is necessary to mix it intimately with oxide of copper and to end the combustion in a long current of oxygen at a temperature near that of the fusion of the glass. Treated with ammoniacal lead acetate, pinite afforded a substance which, on analysis, gave the following numbers :

Carbon .....	12.5%
Hydrogen .....	2.1%
Pb O .....	72.8%

Showing the following composition :  $C_6 H_{12} O_5 \cdot 2 Pb O$ , corresponding to :

Carbon .....	11.8%
Hydrogen .....	2.0%
PbO .....	72.8%

Whence it is concluded that pinite is isomeric with anhydrous mannite and possesses the same composition and formula as quercite.

The specific gravity of pinite was found to be equal to 1.52. Pinite is dextro-gyratory.  $\alpha_D = 58^\circ.6$ . Treated with strong hydrochloric acid and heated to  $100^\circ$  for 10 minutes its rotatory power is not appreciably altered.

Pinite does not ferment, either before or after treatment, with hydrochloric acid. Pinite does not reduce Fehling solution."

The difference between the behavior of the sample examined by Berthelot and called by him pinite, and the sample sent to me was of such a marked nature that I determined to secure, if possible, a larger quantity of the material in order to make a more thorough study of its properties. The chief differences, as will be noticed, were in the specific rotatory power and the percentage composition. The sample examined by Berthelot had a much lower specific rotatory power than the one examined by me and had the composition of the ordinary glucoses; my sample had a much higher rotatory power and the composition of a heptagluucose.

During the Summer of 1889, therefore, I made arrangements with the Director of the Geological Survey to employ one of his men in California for two weeks in collecting samples of this sugar, and, as a result of this work, I received, in the Autumn of 1889, about fifty pounds of a very good article of crude sugar. After the reception of this sample in my laboratory, but before I had commenced to work on it, M. Maquenne published a paper on "A New Sugar With an Aromatic Nucleus," which he named *Beta pinite* and which he claimed was obtained from the *Pinus lambertiana* growing in Nebraska. Inasmuch as this tree does not grow in Nebraska, M. Maquenne was evidently mistaken in regard

to the origin of the sugar. He found the specific rotatory power and percentage composition of the sugar, which he called *Beta pinite*, the same as I found it for the pinite obtained from California. M. Maquenne's paper anticipated in a large degree the work which I had proposed to do on this sample and it is of such interest that the following abstract of it is given :

\* "At present only two sugars are known derived from benzine, viz., inosite and quercite, both of which are changed by the action of hydrodic acid into definite aromatic compounds. The relations of inosite and benzine are more intimate than those of quercite, since by oxidation this latter substance gives a fatty derivative, tri-oxyglutaric acid, instead of quinones or phenols. *Beta pinite* is another of these aromatic sugars derived, according to Maquenne, from the *Pinus lambertiana* from Nebraska (?).

*Beta pinite* melts at  $186^{\circ}$  to  $187^{\circ}$ , and is strongly dextrogyrous. Its specific rotatory power is  $(\alpha)_D = 65^{\circ} .51$ . (Berthelot, pinite  $(\alpha)_D = 58^{\circ} .6$ ). These characters are exactly those of sennite. *Beta pinite* and sennite are probably identical. The analysis of *Beta pinite* gives a formula between  $C_7 H_{14} O_6$  and  $C_8 H_{16} O_7$ . Heated for some minutes to boiling with hydroiodic acid it is decomposed with disengagement of methyl. It represents, therefore, a methylic ether like the sugars of caoutchouc discovered by Girard, and without doubt isomeric with bornesite. If the residue be evaporated to a sirup and alcohol added, there is produced without agitation a crystalline precipitate, which, to the microscope is shown to be made up of small tetrahedra. This new sugar, purified by a second crystallization from weak alcohol, melts at  $246^{\circ}$ . It is very soluble in water, almost insoluble in alcohol (strong), wholly insoluble in ether. Its composition corresponds exactly to the glucoses. Its molecular weight appears to be the same as the glucoses, as determined by Raoult's method. Heated in the sand bath to complete decomposition with nitric acid, rutilant vapors are set free and a white residue is left which, in contact with a solution of sodium carbonate in weak alcohol, precipitates immediately crystals of a black reddish color of sodium rhodizionate. It is

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\* C. R., 109, 81 2.

thus assured for the identification of the salt that it is transformed into tetraoxyquinone under the action of hydrochloric acid and that it gives a red precipitate with barium chloride. The product of the dedoubling of the *Beta pinite* by the hydroiodic acid is certainly an aromatic derivative, very probably an addition product of benzene itself, and consequently an isomer of inosite. It is proposed to designate it by the term *Beta inosite*. It would be interesting to submit the true pinite to the action of hydroiodic acid and to compare it in this respect with *Beta pinite*. For this purpose Berthelot has kindly given me some of his original material, and I have thus been able to notice that this substance is converted, like *Beta pinite*, when it is boiled with hydroiodic acid, into a sugar which melts at  $245^{\circ}$  and presents all the characters of *Beta inosite*, being converted by nitric acid into rhodizonic acid and into tetraoxyquinone. There is produced at the same time a lively effervescence, due without doubt to the escape of methyl iodide. In general the two pinites, and probably sennite, are in close relation with the aromatic series. They form ethers derived from a new principle isomeric with the glucoses and which appear to have the same formula as inosite."

From a careful comparison of the work of Berthelot and Maquenne with the work which I have done on this sugar, I think it is evident at once that there is only one variety of sugar, viz., pinite, and that Berthelot, in the sample which he originally received, was mistaken in assigning it so low a specific rotatory power. It will be noticed that in a portion of Berthelot's original sample, which he sent to Maquenne, the same characteristics were noticed, in so far as they were compared, and which are described by Maquenne in the *Beta pinite*. There is, therefore, little doubt of the fact that what Maquenne calls *Beta pinite* should simply be called pinite and it is important that this mistake of giving the same sugar two different names should be rectified before it has found a permanent place in chemical literature.

The method pursued by me in purifying the crude product was as follows :

The crude sugar contains a considerable quantity of resinous and coloring matter. Its aqueous solution is almost black and has

a pleasant piney odor. The crude sugar was finely powdered and treated with successive portions of boiling 95% alcohol until all the coloring matter soluble therein was removed. After removal of the alcohol the dry sugar was dissolved in water, making a concentrated solution. This solution was still highly colored. It was filtered through boneblack in a hot jacketed filter, by which process the greater part of the coloring matter was removed.

The solution was next treated with a slight excess of basic lead acetate, the precipitate removed by filtration and the excess of lead removed with  $H_2S$ . The filtered solution was then evaporated slowly over a steam bath until the crystallizing point was almost reached and again filtered through hot boneblack.

The solution thus obtained was almost colorless. Two methods of procedure were followed both, of which yielded excellent results.

*First Method.*—The clear solution was evaporated to the crystallizing point, quite a coloration resulting. It was stirred while cooling and a fine mass of small crystals was thus obtained. The concentration should be such that the mass should have a pastry consistence when crystallization is fully accomplished, which requires from two to four days. The crystals are washed with 95% alcohol on a filter until the filtrate shows no further color. The washing is then continued with absolute alcohol until the 95% alcohol is all displaced. The final washings are with ether. The sugar is dried at a very gentle heat (not above  $50^\circ$ ) and then placed on filter paper over  $H_2SO_4$  until constant weight is obtained.

*Second Method.*—The sirup is evaporated to near the point of crystallization and placed in a large jar of which it does not occupy more than one-fourth. The jar is placed on ice, and to the sirup, with constant stirring, three to three and one-half volumes of absolute alcohol are added. The thorough mixture of the alcohol with the sirup is finally conveniently accomplished by blowing through a tube or pipette. The mixture is stirred from time to time to insure small crystals. The deposition of sugar is complete in from ten to fifteen hours. The sugar is washed and dried as before.



The sugar thus obtained is a pure white powder. Twenty-five grains of it occupy a volume of 16.3 cc.; whence its absolute specific gravity is 1.5338. Its specific rotatory power, in varying concentration, is shown by the following data :

Grms. in 100 cc.	Angular Rotation.	(a) <sub>D</sub>
5	6.57	65.05
20	25.98	64.95
25	32.48	64.96
30	39.05	65.08

From the above it is noticed that the rotatory power appears to be independent of the concentration and is almost exactly 65 as a mean of all the results.\* Distilled with sulphuric acid, according to the method used for the production of furfuramide only a trace of this substance was noticed. Oxidized with nitric acid some peculiar reactions were observed as follows :

When the oxidation was carried on in the usual way and stopped at a certain time, large quantities of white rhodozonic acid are produced. Treated with strong nitric acid in an open dish, however, and evaporated to dryness, a peculiar tarry mass is produced, of which the barium salt forms a reddish brown mass the composition of which has not been accurately determined.

From the work of Maquenne, already quoted, it is probable that this substance may be barium rhodizonate. In addition to this a yellowish substance was noticed in small quantities, which is probably due to the formation of picric or croconic acid. Treated with phenylhydrazin in the usual way, pinite gives no osozone; pinite treated with a solution of barium hydrate solution produces an amorphous precipitate, a part of which on standing becomes crystalline. The same is true when treated with calcium and strontium hydrates. Attempts to form the polybasic salts have been only partially successful.

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\*Increasing temperature appears to diminish the rotatory power. A solution which at 5° gave an angular deviation of 14° 32' gave at 82° only 13° 00'. Allowing for the expansion of the solution the reading should have been nearly 14°.

The separation of pinite into two bodies by Maquenne, as indicated in the abstract of the paper given, has been followed by him by a study of these separate bodies, of which the following is an abstract :

\*“The *Beta inosite* produced by heating *Beta pinite* to  $120^{\circ}$  with an excess of hydroiodic acid, as stated in a previous communication, yields a molecule of methyl iodide and a molecule of *Beta inosite*.

Saturated hydroiodic acid, in the presence of a little red phosphorus, easily reduces the *Beta inosite* at  $160^{\circ}$  to  $170^{\circ}$ . There are formed some brown products of a tarry nature and also a substance having the odor of phenol which remains dissolved in the liquid acid. For the determination of this last body, it is converted by the action of iodine, and of potassium in excess, into an insoluble iodine derivative. The body thus obtained is yellow, crystallizable in alcohol or chloroform, in fine needles, fusible at  $159^{\circ}$ , soluble in alkalies and insoluble in water and dilute acids.

Under the influence of boiling nitric acid, this body is transformed into picric acid, easily recognized by its bitter taste and the characteristic aspect of its potassium salt. It is therefore identical with the phenol iodide which before has been obtained from inosite. This result, in addition to the production of quinones in the oxidation of *Beta inosite*, shows that this substance has the formula  $C_6H_{12}O_6$ , characteristic of ordinary inosite.

The study of its ethereal combinations proves that it possesses also with inosite the function of an hexatomic alcohol. Moreover, *Beta inosite* is without action on Fehling solution and upon the phenylhydrazin acetate, which excludes from its molecule the presence of aldehydic or acetic carbonyls. The method of preparing hexacetyl-beta-inosite and hexabenzoyl-beta-inosite is also given.

*Rotatory Power.*—*Beta inosite* is strongly right handed. A 10% solution examined in a 220 mm. tube gave a deviation of  $14^{\circ}.3$  which corresponds to the formula  $(\alpha)_D = 65^{\circ}$ . It is remarkable that the rotatory power is very sensibly the same as that which has been found for *Beta pinite*. In general *Beta inosite* possesses all the chemical properties of the inosite derived from muscles or from leaves. It constitutes, therefore, as that does, an addition product from

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\*C. R., Vol. 109, p. 968.

benzine, a derivative from hexamethylene  $C_6H_{12}$ . It differs from inosite physically by a much greater solubility, by its higher melting point, by its crystallizing form, and by its ethers, which do not resemble any corresponding combinations of inosite; and finally, by its action on polarized light. The latter property would seem to indicate that a molecule of *Beta inosite* is assymmetrical in its constitution, which may possibly be due to its containing two oxhydrys attached to the same atom of carbon.

*Beta inosite* is distinguished from the product recently obtained by Tamret in the action of hydroiodic acid on quebrachite by its point of fusion—it is a little higher, viz.,  $247^\circ$  in place of  $238^\circ$ ;—by its crystallizing form, which is much less marked; by its rotatory power, which is to the right, while the inosite of Tamret is strongly left handed.

*Beta inosite* is also different from the matezodambose of Girard, the rotatory power of which is very small, viz.,  $6^\circ$ .

As a result of these researches, it follows that pinite constitutes the monomethylene of *Beta inosite* and that its formula is  $C_7H_{14}O_6$ . This important principle is, therefore, an isomer of bornesite and of quebrachite, that is to say, it is a body absolutely distinguished in its composition and its chemical function from quercite.”

Girard has shown, however, that the *Beta pinite* and the *Beta inosite* described by Maquenne, are identical with the sugar obtained by him from caoutchouc and which he calls matezite; and that the *Beta inosite* is identical with another sugar called matezodambose. The abstract of the work of Girard showing these analogies follows;

\*“Girard has abstracted from the juice of the caoutchouc of Madagascar, a sugar which he has named matezite. Treating this substance by hydroiodic acid in a concentrated state, and at the boiling temperature, it is broken up into the iodide of methyl and a sugar isomeric with the glucoses, namely, matezodambose. Shortly after, there was found in commerce, under the name of pinite, a sugar extracted from the *Pinus lambertiana* which Maquenne calls *Beta pinite* to distinguish it from the pinite of Berthelot. When this sugar is treated with hydroiodic acid it is

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\*C. R. Vol. 110, p. 46.

broken up into methyl iodide and into a sugar which resembles inosite, which is called *Beta inosite*. Struck with the analogies of this substance with the caoutchouc sugar, Combes has identified *Beta pinite* and *matezite* as the same sugar, and *Beta inosite* and *matezodamzite* as the same sugar." The following is a table of the physical constants of the various substances :

	Matezite.	B. Pinite.	Matezodambose.	B. Inosite.
Melting point.....	187°	186°.5	246°	246°
Rotatory power.....	66°	65°.7	67°.6	68°.4

The rotatory powers are determined by solutions containing 2% of the material. From what precedes, it is evident that *Beta pinite* and *Beta inosite* are not new chemical compounds.

It is seen from the above data that we have in this exudation of the *Pinus lambertiana* a chemical body of the most remarkable and interesting properties. It is evident that the study of these properties has only been well commenced, and with the large quantities of material which are now at my disposal I hope at a subsequent time to add something more to our knowledge concerning it.

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## ANALYSIS OF A PEKOE CEYLON TEA.

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BY JOSEPH F. GEISLER.

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This sample of tea would be considered a curiosity by most people, inasmuch as its appearance is so different from that of the usual varieties of teas met with in commerce. It is a fine Pekoe Ceylon Tea, and its appearance shows it to consist of a mixture of small dark and yellow leaves, the latter predominating. These small leaves are tightly rolled into coils varying from  $\frac{1}{4}$  to  $\frac{1}{2}$  inch in length, the greater portion being about  $\frac{5}{16}$  inch long, with an average diameter of about  $\frac{1}{32}$  inch. The small, light, yellowish colored coils are completely covered with hair, giving some a silvery appearance.

When treated with boiling water the stemlike cylinders are shown to be thick leaves about  $\frac{1}{4}$  in. wide, of a leathery texture, very glossy on the inner surface, with prominent midrib, the edges and midrib along the back of the leaf being covered with hair. The small cylinders reveal themselves as leaves  $\frac{3}{16}$  in length and about  $\frac{1}{16}$  in. wide, while the very small ones are principally a mass of hairs.

The analysis of the tea gave the following data :

Moisture (loss by drying at 100° C.) .....	6.20%
Soluble ash .....	3.77%
Insoluble ash .....	1.53%
Total ash .....	5.30%
Theine .....	2.54%
Total tannin .....	22.79%
Total extractive matter .....	43.40%
Insoluble leaf .....	50.40%

In the above data there is nothing particularly noteworthy excepting that the per cent. of tannin is very high.

An infusion of the tea was made by treating one (1) part of tea with 100 parts of boiling distilled water and allowing 10 minutes for the maceration. Under these conditions the tea yielded to water the following percentages :

Theine .....	2.44%
Tannin .....	17.19%
Total extractive matter .....	33.25%
Ash (total) .....	3.44%
Phosphoric acid ( $P_2O_5$ ) in ash .....	6.18%

The alkalinity of the ash was equivalent to 1.798% of  $K_2O$ .

The infusion obtained was of a dark golden yellow color, and had a very agreeable aroma and pleasant taste. From the above it will be seen that the infusion took up 96.6% of the total theine 75.3% of the total tannin, and 91% of the soluble ash, data characteristic of a fine tea, as will be seen on comparison with analyses of teas of commerce reported by the author in 1889.\*

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\* See Prescott's Organic Analysis, pp., 504-512.

# Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

September 1, 1891.

**458,561.**—Method of extinguishing fires. George Dickson, Toronto, and David A. Jones, Beeton, Canada.

**458,563.**—Process of making caustic alkali. Francis Ellershausen, Heburn-on-Tyne, Eng.

Solutions of sodium or potassium sulphide are passed through a filter bed composed of granulated sodium or potassium ferrate.

**458,607.**—Device for cooling liquids. Carl W. Weiss, Brooklyn, N. Y.

**458,647.**—Process of obtaining glycerine from soapmakers' waste. Joseph Van Ruymbeke, Chicago, Ill.

**458,648.**—Plant for treating soapmakers' waste to obtain glycerine. Joseph Van Ruymbeke, Chicago, Ill.

**458,652.**—Electro-chemical transformer. Turner D. Bottome, Hoosick, N. Y.

**458,663.**—Manufacture of flexible photographic films. Henry M. Reichenbach and Samuel C. Passarant, Rochester, N. Y.

A flexible film support made by adding a distillate obtained from zinc chloride and fusel oil to a fluid solution of nitro-cellulose and camphor, and subsequently depositing and spreading such solution upon a rigid supporting surface and drying it.

**458,726.**—Chemical refrigerator. Ralph Hirsh, Syracuse, N. Y.

**458,741.**—Process of making ink. Edward Watson, Grand Rapid, Mich.

Coal tar and sulphuric acid are mixed in about equal proportions at a temperature not exceeding 200° F. and then washing out the acid and mixing with dilute alkali to the required consistency.

**458,742.** ) —Compositions of matter for restraining the setting of plaster.

**458,743.** ) Edward Watson, Grand Rapids, Mich.

**458,744.**—Manufacture of Fertilizers. Edward Watson, Grand Rapids, Mich.

Process of converting tank water into a practically dry non-deliquescent fertilizer by adding thereto a portion of other animal matter, an alkali, and drying the product.

**458,764.**—Method of producing marbled surfaces. Soren C. Madsen, Sleepy Eye, Minn.

Sand, broken glass and broken smoked glass are sprinkled over the surface of clear glass, placed over a sensitized surface and then exposed to the sun's rays or artificial light.

**458,784.**—Method of and apparatus for determining the temper of steel. Carl A. Caspersson, Forsbacka, Marzretchill, Sweden.

**458,798.**—Ammonia still. George Stroh and George Usius, Detroit, Mich.

**458,822.**—Bleaching apparatus. E. B. Newcomb and F. A. and F. H. Cloudman, Cumberland Mills, Me.

**458,823.**—Amalgamator. Henry Cook, Philadelphia, Pa.

**458,828.**—Process of preparing skins. George H. Farthing, San José, Cal.

**458,837.**—Ore washer and concentrator. Charles F. Pike, Philadelphia, Pa.

**458,840.**—Waterproofed parchment paper. Emery Andrews, Kennebunk, Me.

**458,887.**—Apparatus for purifying water. Easton Devonshire, London, Eng.

**458,987.**—Apparatus for impregnating gases with vapors of volatile substances. Edward Blass, Essen-on-the-Ruhr, Germany.

**458,946.**—Water purifier. Easton Devonshire, London, Eng.

**458,958.**—Ore washer or concentrator. Chas. F. Pike, Philadelphia, Pa.

**458,985.**—Making vinegar. Gustav Sobotka, New York, N. Y.

**458,986.**—Process of producing clear wort. Gustav Sobotka, New York, N. Y.

*September 8, 1891,*

**459,023.**—Process of extracting antimony from ores. Curt Schreiber and Hans Kruetsen, Broken Hill, New South Wales.

The crushed ore is subjected to the action of a solution of sodium sulphide and the antimony then precipitated in metallic form by electrolysis.

**459,034.**—Process of recovering tin from waste tin plate. Jean M. G. Bonnet, Paris, France.

The tin scrap is subjected to the action of an "alkaline solution" and simultaneously forcing hot air into said solution, thus getting the tin in the form of stannate, from which it is afterward recovered.

**459,048.**—Process of casting steel carwheels. William G. Richards, Boston, Mass.

**459,066.**—Process of treating fabrics for ornamentation. Gustav Glock, Newark, N. J.

**459,123.**—Apparatus for the distillation of tar. Frederick Lennard, East Greenwich, England.

**459,136.** ) —Processes of preparing plates for purposes of utility or orna-

**459,137.** (       ment. Hannibal Goodwin, Newark, N. J.

**459,198.**—Process of making ammonia and gas. Alphonse Hennin, Springfield, Ill.

Gas and ammonia are made simultaneously "by injecting air or oxygen and steam into a bed of incandescent fuel, controlling the temperature of the generator, first, by introducing such proportions of steam and oxygen or air as to maintain a zone of combustion at a temperature sufficient to reduce to carbonic oxide (CO) practically all the carbonic anhydride (CO<sub>2</sub>) formed by the complete combustion of the fuel and to decompose practically all the steam so introduced in the blast; and, second, by regulating the supply of fresh fuel to maintain beyond the zone of combustion a zone of distillation, cool enough not only to allow the formation of ammonia, but to prevent the disassociation of that already formed, leading off the ammonia and gas and separating them by condensers, washers, or other suitable means."

**459,236.**—Process of purifying brine. Caleb G. Collins, Kearney, N. J.

The brine is purified by "rendering the impurities insoluble by subjecting the brine to a current of electricity having an electromotive force not exceeding two and one-half volts, sufficient to decompose the impurities in the brine, but below the intensity necessary to decompose the sodium chloride in the brine," etc.

**459,267.**—Centrifugal concentrator for minerals, etc. Thomas Clarkson, London, England.

**459,284.**—Sterilizing apparatus. Johann F. H. Gronwald and Emil H. C. Oehlmann, Berlin, Germany.

**459,302.**—Sterilizing apparatus. Emil H. C. Oehlmann and J. H. C. Gronwald, Berlin, Germany.

**459,315.**—Centrifugal separating machine. Richard Stanfield, Edinburgh, Scotland, and Thomas Clarkson, London, England.

*September 15, 1891.*

**459,475.**—Brine evaporating apparatus. Lowthian Bell, Northallerton, England.

**459,494.**—Composition of matter for the purification and strengthening of iron and cast steel. Charles L. Hartsfeld, Newport, Ky.

**459,496.**—Method of extracting cane juice and apparatus therefor. Alfredo Leblanc, Havana, Cuba.

**459,556.**—Process of electrolytically obtaining zinc. Alexander Watt, London, England.

**459,575.**—Process of making phosphoric acid. Charles Glaser, Baltimore, Md.

**459,579.**—Carburetor. George Hargreaves, James P. Scranton, Edward W. Porter, Detroit, Mich.

**459,611.**—Method of uniting solderable surfaces with aluminium. Thomas G. F. Dolby, Elgin, Ill.



**459,632.**—Vulcanizing apparatus. William E. Hathaway, Hornellsville, N. Y.

**459,639.**—Amalgamator. Peter B. Mathiason, St. Louis, Mo.

**459,654.**—Diffusion apparatus. Reginald M. Sandys, New Orleans, La.

**459,659.**—Ore crusher. August H. Schierholz, San Francisco, Cal.

**459,684.**—Ore concentrator. Andrew Fraser, San Francisco, Cal.

**459,688.**—Process of making soda with strontium salts.

Sodium or potassium hydrate are produced by reacting with the respective sulphates upon strontium hydrate, recovering the strontium by treatment with magnesium carbonate, followed by heating the strontium carbonate thus produced in an atmosphere of steam, etc.

**459,693.**—Fluid-fuel limekiln. Walter B. Wright, Chicago, Ill.

**459,712.**—Automatic gas generating machine. William F. Singer, Carthage, Syracuse, N. Y.

*September 22, 1891.*

**459,744.**—Mechanical dyeing apparatus. Thomas A. Clough, Philadelphia, Pa.

**459,751.**—Compound for preserving ships' bottoms, etc. Beau Hooker, San Diego, Cal.

**459,799.**—Kiln. Sterling G. Valentine, Lebanon, Pa.

**459,858.**—Ore concentrator. Chas. E. Seymour, Hurley, Wis.

**459,897.**—Moth-proofed hair and process of preparing the same. John Ruch and John Ruch, Jr., Philadelphia, Pa.

**459,925.** Gas generator. Chas. F. Cattelli, Darby, Pa.

**459,946.**—Manufacture of white lead. David V. Kyte, Indianapolis, Ind.

A metallic lead anode is decomposed " by a current of electricity in an acid electrolyte to form oxygen-bearing salts of lead, then rendering the electrolytic solution neutral, or nearly so, and treating the electrolyte with carbon dioxide for the purpose described."

**459,993.**—Process of tanning. Henry Churchill, Rochester, N. Y.

**460,004.**—Apparatus for the manufacture of phosphorus and alkaline silicates. Louis M. C. Foliedesjardins, Toulouse, France.

**460,028.**—Method of and apparatus for manufacturing ice. Edward A. Quisenberry, Lexington, Va.

**460,028.**—Manufacture of ice. Edward A. Quisenberry, Lexington, Va.

**460,030.**—Apparatus for deaerating water. Edward A. Quisenberry, Lexington, Va.

**460,056.**—Process of manufacturing a composition applicable for electrical insulating purposes. Ernst Fahrigh, London, England.

**460,086.**—Artificial horn and method of producing the same. William Harvey, Philadelphia, Pa.

Consists of plastic materials such as celluloid, pyroxyline, or zylonite, etc.

*September 29, 1891.*

**460,105.**—Artificial stone, cement, and plastering composition. Edgar H. Benedict and Francis G. Bates, Philadelphia, Pa.

**460,112.**—Apparatus for coating wire with other metal. John Coffin, Johnstown, Pa.

**460,122.**—Process and apparatus for generating electricity. Thomas A. Edison, Menlo Park, N. J.

**460,187.**—Ammonia still. Daniel L. Holden, New York, N. Y.

**460,186.**—Process of making dimethylphenylpyrazolone. Ludwig Scholvien, Berlin, Germany.

Molecular quantities of methylphenylpyrazolone and sodium methyl sulphate are heated in presence of hydriodic acid and of a diluent.

**460,193.**—Smelting furnace. William L. Austin, Toston, Mont.

**460,195.**—Artificial stone. George H. Blake, Portland, Me.

Composed of graphitic slate and an alkaline silicate.

**460,227.**—Insecticide. Richard Wheeler, San Francisco, Cal.

Consists of lime, sulphur and salt.

**460,271.**—Process of filtration. John Sutton, Islip, N. Y.

**460,305.**—Amalgamating apparatus. Homer W. Fiske, New York, N. Y.

**460,311.**—Filter. Benjamin F. Perkins, Holyoke, Mass.

**460,320.**—Cereal food and process of producing the same. James A. Currie, Springfield, Ohio.

**460,354.**—Apparatus for electrolytically separating metals from ores. Werner von Siemens, Berlin, Germany.

**460,358.**—Method of decorating glass articles. William Buttler, Washington, Pa.

**460,370.**—Process of extracting bromine. Herbert H. Dow, Cleveland, Ohio.

The bromine is first freed from its chemical combination, then separated from the brine by means of an air blast, and forcing the bromine laden air through a metal or substance that will combine with the bromine, thus producing a bromide, etc.

**460,377.**—Process of making presser pads for lasting machines. David Lake, Hornellsville, N. Y.

**460,378.**—Filter. Prosper A. Maignen, London, England.

**460,405.**—Process of treating iron. John A. Stephan and Richard Southerton, Birmingham, England.

Process of incorporating a mixture of emery and ammonia alum with the molten metal during the puddling operation.

**460,509.**—Process of preparing and tempering slurry for portland cement. George H. Kalteyer, San Antonio, Texas, and George W. Bartholomew, Jr., Bellefontaine, Ohio.

J. F. G.



REGULAR MEETING, November 6, 1891.

The regular meeting was called to order at 8:30 in the Law Lecture Room, University Building. Prof. A. A. Breneman in the chair.

The minutes of the October meeting were read, amended and accepted.

Prof. McMurtrie read the report of the Committee on Nominations giving the form of ballot decided upon and the names of nominees for the annual election.

After some discussion the report of the Committee was adopted.

The following nominations for membership were made :

Guy E. Couch, 44 W. Court St., Cincinnati, O.

J. C. Dittrich, 128 E. 54th St., N. Y.

Walter D. Field, 40 S. Portland Ave., Brooklyn, N. Y.

Wm. J. Karslake, 7 Kay St., Newport, R. I.

J. U. Lloyd, E. Norwood, Ohio.

Jas. H. Hyndman, 98 W. 9th St., Cincinnati, O.

Wm. N. Mumper, Hughes High School, Cincinnati, O.

H. T. Nichols, Avondale, Cincinnati, O.

Prof. T. H. Norton, Univ. of Cincinnati, Cincinnati, O.

Prof. L. M. Norton, Mass. Inst. of Technology, Boston.

W. Simonson, 9th and Race Sts., Cincinnati, O.

Dr. Sigmond Waldbott, 150 E. 5th St., Cincinnati, O.

E. C. Wallace, 62 Loth St., Cincinnati, O.

B. D. Westenfelder, Am. Oak Leather Co., Cincinnati, O.

Prof. Chancy R. Stuntz, Woodward High School, Cincinnati, O.

Earnest Twitchell, 559 W. 7th St., Cincinnati, O.

The following members were then elected :

Frank H. Andrews, Providence, R. I.

Lyman C. Newell, Providence, R. I.

Clarence E. Wilson, Providence, R. I.

The following papers were read :

On the Decomposition of Sodium Nitrate by Sulphuric Acid and the Distillation of Nitric Acid by C. W. Volney, Ph. D.

Historical notice. Early mention of Areometers. By A. Bourgougnon.

The meeting was then adjourned.

DURAND WOODMAN,  
*Recording Secretary.*

# ON THE DECOMPOSITION OF SODIUM NITRATE BY SULPHURIC ACID AND THE DISTILLATION OF NITRIC ACID.

By DR. C. W. VOLNEY.

When distilling nitric acid from the usual mixture of sodium nitrate and sulphuric acid, it is frequently observed that at certain periods a violent reaction sets in, and that the contents of the retort are carried over in the receivers. The general supposition is that its cause is overheating, and to prevent it, the distillation is carried on at a low temperature, and the retorts are made of such capacity that the foaming may spend itself without reaching the conducting tube and running over.

However, it can be observed that the foaming of the retort contents occurs at certain periods of the continuation of the process even when only a very moderate heat is applied, and is therefore dependent not merely upon its external application; and as it does appear that the distilling acid has a close connection with the reaction taking place in the retort, in relation to boiling point and constitution, a consideration of the qualities of nitric acid of different concentrations will serve in the explanation of these different reactions, especially during the distillation of the acid from the mixture of sodium nitrate and sulphuric acid.

A. Smith <sup>1</sup> found that a nitric acid of the constant boiling point  $81,56^{\circ}\text{C}$  had a specific gravity of 1.503—1.51, and was the first hydrate,  $\text{NO}_5\text{HO}$  or  $\text{HNO}_3$ ; also that an acid, boiling constantly at  $121^{\circ}$ , had the specific gravity 1.41 and was the second hydrate  $\text{NO}_5,2\text{HO}$  or  $\text{N}_2\text{O}_5,2\text{H}_2\text{O}$ .

Roscoe <sup>2</sup> states, that by boiling nitric acid of any concentration a residue of constant specific gravity 1.41 and boiling point  $120.5$  remains; this seems to correspond with Smith's second hydrate.

The existence of definite hydrates of nitric acid has been questioned frequently, but the corresponding boiling points and specific

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<sup>1</sup> A. Smith, *Phil. Magazine* (3) 31, p. 454.

<sup>2</sup> Roscoe, *Jahresbericht* 1860, p. 65.

gravities, as well as some reactions in the decomposition of nitrates in presence of water, and the fact that not only anhydrous nitric acid, but also the hydrates, when brought in contact with water, develop heat, cannot very well be explained except upon the theory that several chemical combinations with water exist. Discrepancies in boiling points as well as in specific gravities are always likely to exist, also, the first and second hydrate are constantly decomposing, especially under the influence of light, and this cannot therefore be held as a valid objection to the theory of distinct hydrates. In the preparation and manufacture of nitric acid, the processes and reactions can best be explained by the acceptance of the several hydrates of nitric acid, and the following table of observations furnishes a direct proof of it.

I concluded to conduct the experiments with, comparatively speaking, large quantities, and as I had facilities for obtaining strong acid for the preparation of nitro-compounds and organic nitrates, I had occasion to repeat my observations. The table thereof, which I give here, refers to the distillation of the acid from a mixture of 2500grms. sodium nitrate and 2600grms. of commercial sulphuric acid of 1.837 specific gravity at 67° F. The tubulated glass retort had a capacity of about two gallons, was provided with a thermometer in the tubulus and heated in a paraffine bath the temperature of which could also be ascertained by thermometer. The bulb of the inside thermometer did not reach the mixture in the retort and indicated the temperature of the distilling vapors. The condensation was effected by a Liebig's condenser, whereby an exchange of receivers was rendered easy.

I noted, during the distillation, the time, the temperature, as indicated by the in- and outside thermometer, and the quantities of acid received in different periods; the reactions of the contents of the retort were also observed. These notes are contained in the following:

Time.	Temperature		Remarks.
	Outside.	Inside.	
A. M. 10.10	83°	45°	Reaction commences.
11.30	85°	47°	Gas forming; mass caking.
11.45	90°	50°	“ “
	94°	52°	“ “

Time.	Temperature		Remarks.
	Outside.	Inside.	
A. M. 11.45	97°	55°	Gas forming, mass caking.
	102°	58°	“ “
11.53	106°	65°	Red vapors appear.
	110°	70°	The red vapors lessen.
	118°	75°	Disappear; white fumes.
	120°	77°	Salt in retort melts; acid vapors distil over.
Noon. 12.00	122°	80°	Mass is foaming; nitrate dissolves rapidly; nitric acid distils well.
P. M. 12.10	122°	81°	Contents of retort are foaming strongly; acid distils rapidly.
12.15	122°	81°	Foaming; contents have risen two inches.
12.16	122°	81°	Foaming; contents have risen two inches.
12.16	122°	81°	The fire lessened to prevent running over.
12.20	120°	80°	Acid distils rapidly and quietly.
	118°	80°	Danger of running over is past.
	115°	81°	Distils well and quietly; I increase fire.
12.30	117°	88°	Distils well; foaming commences again.
12.47	118°	88°	Distils well; foaming commences again.
1.00	120°	90°	Distilling and foaming.
1.10	122°	90°	Distils more slowly; foaming increases.
1.37	125°	90°	Distils less, but foams strongly.
1.45	130°	90°	I increase the fire.
2.00	130°	90°	Foaming; keep up a brisk fire and change the receivers.
2.10	131°	90°	Foaming; commences to distil again.
2.20	131°	90°	Distillation ceases; foaming.
2.45	130°	94°	“ “ “

Time.	Temperature		Remarks.
	Outside.	Inside.	
P. M. 2.50	130°	97°	No distillation.
3.00	135°	100°	
3.10	138°	100°	Commences to distil.
3.20	138°	100°	“ “
3.25	138°	101°	Increase firing.
3.30	138°	101°	Little distillation.
3.36	139°	103°	Distilling.
	141°	104°	“
3.40	142°	105°	“
3.45	142°	105°	Liquid in retort is boiling and foaming
	143°	106°	and distilling.
	144°	108°	Distils slowly; the condenser is cooling; increase the fire.
3.53	144°	108½°	It distils again.
4.05	146°	107°	Keep up fire well.
4.15	146°	108°	Foaming and distilling well.
	146°	109°	Liquid is boiling and distilling well.
	147°	109°	It lessens and red vapors appear.
4.20	148°	109°	Distillation lessens; increase the fire again.
4.25	150°	110°	Distillation ceases entirely; condensing tube cools down; change receivers and increase the fire still more.
4.30	151°	110°	No distillation.
4.35	153°	112°	No distillation; foaming a little.
4.40	155°	113°	“ “
4.50	160°	115°	Liquid in retort shows signs of boiling.
5.00	163°	117°	Foaming and distilling a little.
5.10	163°	118°	“ “ “
5.15	164°	119°	Liquid boils and distils.
5.20	165°	119°	“ “ “
5.25	164°	120°	Distils well.



	Time.	—Temperature—		Remarks.
		Outside.	Inside.	
P. M.	5.30	165°	121°	Distils well.
	5.35	166°	122°	“ “ Red vapors appear; distillation lessens; increase fire.
	5.45	166°	121°	Little distillation; red vapors lessen; condensing tube cools.
	5.55	167°	122°	No distillation; tube cools; extinguish fire.

It will be seen that as the periods of this distillation changed, I changed the receivers, and thus obtained three different products, which were weighed and examined.

The first fraction received between 77°–90°, 960g. of 1.5193 sp. gr. at 60° F., almost white. The second fraction, 565grms. of 1.505 sp. gr. and received between 94° and 109°, was nearly white and but slightly yellow. The third portion, which had distilled between 117° and 122°, was light yellow, weighed 316grms., and had a sp. gr. of 1.42.

The first two portions mixed gave 1525grms. of 1.510 sp. gr., which corresponds with the first hydrate usually produced. I have not succeeded in obtaining an acid of over 1.52, and even this had always more or less NO<sub>2</sub> absorbed. I considered this product, therefore, as the yield of first hydrate. As shown in the foregoing notes, this whole product is received between 84° and 109°; it marks at the latter temperature the point where the greatest portion of the acid of the lower boiling point has distilled at the moment of being set free by the decomposition of the nitrate in the retort. This acid should all have gone over at 84°, but below the 109° there are always portions of the sodium nitrate still left undecomposed, and whenever such portions are becoming heated to the point of dissociation they dissolve in the contents of the retort, the foaming spoken of appears and a portion of first hydrate sets in, whereas acid containing more water and of a higher boiling point remains in the retort and only small portions of which of it are carried over with the vapors of the first hydrate. This may explain the occurrence of the second fraction, which ceased to

go over at  $109^{\circ}$ . At this temperature, all sodium nitrate in the retort is decomposed and the retort contents now consist only of sodium bisulphate and trisulphate and nitric acid of the second hydrate, or of acid which boils at  $120^{\circ}$ – $121^{\circ}$  and can be distilled over at this temperature. After this, there is still left always a little nitric acid in the retort, which can be distilled only at a higher temperature and is thereby very considerably decomposed. The acids which may now be obtained contain a weaker nitric acid which has absorbed sometimes considerable dioxyde, coloring it red and giving it a high specific gravity.

From the foregoing observations, I conclude that sodium nitrate is not fully decomposed by sulphuric acid at a low temperature, but only under application of heat; that the first hydrate distils always shortly after being set free, and that the temperature of the mixture remains stationary as long as only this acid is formed. Whenever the decomposing temperature of the nitrate is reached, the first hydrate is suddenly liberated and thereby causes the foaming in the retort. At the same time the nitric acid which, in the retort, has occasion to form the second hydrate, remains until the sodium nitrate is entirely decomposed, from which period on a second hydrate and weaker acid of a higher boiling point distils, there being now in the retort only the different sulphates of sodium and nitric acid.

The foregoing also tends to explain why it takes so long to effect the apparently simple decomposition and distillation and why a strong fire is useless and even injurious to quality and yield of acid. A strong fire will invariably overheat the retort and decompose large quantities of nitric acid, especially the first hydrate. On the other hand, the nitrates could not be decomposed by mixing with sulphuric acid nor the first hydrate be produced therefrom by a simple distillation, because at the temperature at which the nitrate is decomposed the first hydrate boils and thus keeps the temperature of the retort nearly stationary until it is distilled off and the acids of a higher boiling point appear.

## HISTORICAL NOTICE.

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### EARLY MENTION OF AREOMETERS.

Compiled by A. BOURGOUGNON.

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Towards the end of the fourth and the beginning of the fifth centuries of the Christian era a celebrated woman, Hypatia, born in the year 370, taught the doctrines of Neoplatonism in the school of Alexandria. She died in 415, massacred by the fanatic followers of St. Cyrille.

To Hypatia the invention of areometers has been attributed. As her writings were destroyed with the burning of the library of Alexandria, this assumption is based upon a letter which she wrote to one of her pupils, Synesius, a Greek writer, who afterwards became bishop of Ptolemais, in 410, and died in 431.

The letter of Hypatia has been translated by F. Hoefer, and is found in his *Histoire de la Physique et de la Chimie, Paris, 1872*. It reads as follows :

“ I am so ill that I need an hydroscope. I wish that you would  
“ have one made in copper for me. It is a pipe of a cylin-  
“ drical form, having the shape and the length of a whistle. On  
“ its length it carries a straight line cut across by several small divis-  
“ ions by which we can tell the weight of the waters. At the end is  
“ a cone having the same base as the cylinder. This instrument is  
“ called *Baryllion*. When placed in water by the pointed end it  
“ stands perpendicularly; the divisions cutting the longitudinal  
“ line can be counted, and therefore the density of the water  
“ be known.” \*

None of the commentators of the letters of Synesius could give an explanation of this instrument.

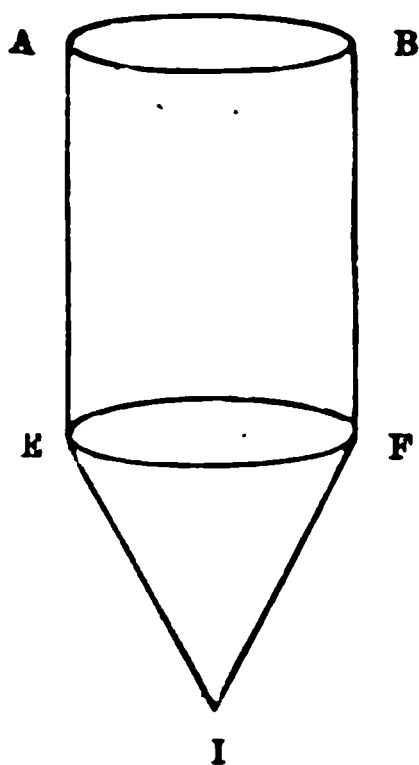
Benoit Castelli (born at Brescia in 1577, died at Rome, 1644) consulted the celebrated Fermat on this subject.

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The following is the explanation of the great mathematician, as reported by Castelli in his *Traité de la Mesure des eaux Courantes*,† and found also in Fermat, *Opera Varia*:‡

“This instrument recorded the density of waters to be used by sick persons, the physicians having observed that the lighter were the best; the expression  $\rho\pi\eta$  (weight) employed by Synesius shows it clearly. This word does not mean here *libramentum*, as was thought by P. Petau, but weight or density, called by the Latins *momentum*. As the balance could not give exactly the difference of weight or the density of waters, the mathematicians invented, according to the principle of Archimedes (*De his quæ vehuntur in aqua*), the instrument described in the letter of Hypatia. The following is its figure :



A F is a copper cylinder. A B the upper part, always open. E F, the lower part, closed by the cone E I F, having the same base as the cylinder. A E and B F are two straight lines cut by several small divisions. If the instrument is placed in water, point down, and adjusted so as to stand in an erect position, it will sink to a certain point, which will be marked by one of the transverse lines, and it will sink differently in different waters, as will be easy to demonstrate.”

Prior to Hypatia, Rhemnius Palemon, a Roman grammarian, contemporary of Tiberius, had given in his poem, *De ponderibus et mensuris*, a very detailed description of areometers and the rules to be followed in their construction.

This author attributed their invention to Archimedes.

The description of Palemon is as follows : ||

“ Ducitur argento, tenuive ex aere cylindrus,  
 “ Quantum inter nodos fragilis producit arundo.

† Rome, 1628.

‡ Toulouse, 1679.

| Leyden, 1587.

“ Cui cono interius modico pars ima gravatur,  
“ Ne totus sedeat, totiusve supernatet undis  
“ . . . . Hoc cujusque potes pondus spectare liquoris  
“ Nam si tenuit erit, majori immergatur unda ;  
“ Sin gravior, plures modulus super esse notabis,” etc.

And reads thus :

A very thin cylinder of silver or copper is made, having its length equal to the distance separating the knots of a frail reed ; its lower part is so loaded with a small, cone-shaped weight as to prevent it from sinking entirely or floating horizontally. With this instrument the weight of a liquid can be known; if it is light, a large part of the cylinder is immersed; if it is heavy, a greater number of divisions are observed above the liquid.

The physicists of the Eighteenth Century, Fahrenheit, Nicholson, Baumé, must have employed these directions to construct their areometers, although they did not give their origin.

## Abstracts of American Patents Relating to Chemistry.

*(From the U. S. Patent Office Gazette.)*

*(Issued October 6th, 1891.)*

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**460,685.**—Apparatus for coating plates with tin. Henry F. Taylor and William B. Struse, Briton Ferry, Eng.

**460,697.**—Hydraulic lime. John H. Wright, Louisville, Ky.

Crude potash, crude soda ash, alum, sulphate of lime and water are combined with unslaked lime.

**460,722.**—Apparatus for washing and separating gold and silver from their ores. William J. Tanner, London, Eng.

**460,732.**—Ore separator. Horace H. Taylor, Fresno, Cal.

**460,733.**—Ore feeder. James Tulloch, Angel's Camp, Cal.

**460,814.**—Concentrator. Gustav Lang, San Francisco, Cal.

**460,842.**—Composition of matter for soles of shoes. George E. Brown and John W. Blackwell, Wrentham, Mass.

A composition of rubber, litharge, whiting, flour of sulphur, lamp black, and a gritty substance.

**460,861.**—Preserving compound. James M. Gillihan and Thomas J. Gillihan, Olathe, Kans.

Nitrate of potassium, sulphur and salicin are the preservatives used.

**460,985.**—Process of making sodium or potassium. Curt Netto, Dresden, Saxony, Germany.

Process for the production of potassium or sodium from their hydroxides in a continuous operation, which consists in bringing the caustic alkali into contact with the reducing carboniferous matter at such a low temperature that only the caustic alkali is reduced to a metallic state, while the alkali carbonate simultaneously formed remains undecomposed

and is withdrawn out of the reach of the reducing carboniferous matter without interruption of the reducing process or the admission of air to the reducing vessel or retort during the reducing operation.

**460,989.**—Process of preparing wort. Carl Rach, Chicago, Ill.

A mash of malt is first made and separated into thin liquid and a thick mash; second, the thick mash is cooked at the boiling point; third, making a mash of natural cereals mixed with a small per cent. of malt and stirred and cooked under pressure; fourth, mixing, cooling and stirring the two thick mashes above referred to; fifth, cooling this mixture and the thin liquid above referred to to about 158° F., and mixing half of the thin liquid with the mash; sixth, letting the mash stand until the erythrodextrine reaction has ceased; seventh, raising the temperature of the remaining thin liquid to boiling point and then mixing it with the mash so as to raise the temperature of the whole to 176° to 178° F.; eighth, drawing off the wort in the ordinary way.

**461,010.**—Process of removing lime from hides. Charles W. Cooper, Brooklyn, N. Y.

The said materials are subjected in a bath of water to carbonic acid gas.

**461,024.**—Composition for electric batteries. Daniel M. Lamb, Boston, Mass.

**461,026.**—Compound for electric batteries and method of preparing the same. D. M. Lamb, Boston, Mass.

**461,034.**—Process of making quick malt. Martin L. Mowrer, Dayton, O.

Malt is soaked in water of a temperature of 100 to 150° F. for a period of about six hours, then slowly drained for about the same length of time, then crushed and dried.

**461,050.**—Crushing machine. Wilhelm Schranz, Laurenburg, Germany.

**461,086.**—Blue azo dye. Gustav Schulz, Berlin, Germany.

Hexa azo dyes derived from one molecule of toluidine or anisidine, one molecule of alpha-naphthylamine, and two molecules of an alpha-naphthol disulpho acid. The dyes are insoluble in alcohol, readily soluble in water and sulphuric acid, and are not readily affected by air and light.

**461,108.**—Process of tanning. Robert W. Turner, Dublin, Tex.

The hides are subjected first to a weak solution and then to a strong solution of an infusion of the plant *Amphiachyris Draconculoides*.

**461,164.**—Process of making fertilizer from stick. Joseph Van Ruymbeke, Chicago, Ill.

The stick is first treated with sulphates in the usual way, then dissolved in sulphuric acid, and then mixing therewith tribasic phosphate of lime and allowing the mass to lie until apparently dry.

**461,235.**—Device for feeding chemicals to filters. Thomas H. Butler, Baltimore, Md.

**461,251.**—Art or method of galvanizing metal. Henry K. Swinscoe, Clinton, Mass.

**461,260.**—Hemp or flax decorticating machine. Augustus E. Ellinwood, Akron, O.

**461,343.**—Method of and apparatus for producing from coal smokeless flame for heating. William A. Koneman, Chicago, Ill.

**461,365.**—Process of preserving timber. James McKeon, Oakland, Cal.

**461,372.**—Jelly extractor. Rose Smith, Grand Rapids, Mich.

**461,394.**—Process of and apparatus for manufacturing gas. James M. Rose, Alleghany, Pa.

*(Issued October 20th, 1891.)*

**461,416.**—Process of obtaining alumina from bauxite. Joseph A. Bradburn and John D. Pennock, Syracuse, N. Y.

The process consists in oxidizing the iron and organic matter by treatment with a hypochlorite and carbonic acid gas, then treating the oxidized bauxite with caustic soda solution, filtering out the liquor, precipitating the hydrate of aluminum, and calcining it.

**416,425.**—Ore concentrator. Frederick M. Endlich, Ouray, Col.

**416,429.**—Mining sulphur. Herman Frasch, Cleveland, Ohio.

The process consists in liquefying the sulphur in the mine by fusion and removing the melted sulphur.

**461,430.**—Apparatus for mining sulphur. Herman Frasch, Cleveland, Ohio.

**461,431.**—Mining sulphur. Herman Frasch, Cleveland, Ohio.

A sulphur solvent is used to remove the sulphur from the underground deposit.

**461,467.**—Composition of matter for insulating purposes. Marcus O. Farrar and Charles C. Howe, Bristol, N. H.

**461,513.**—Lubricant. Adolph Sommer, Berkeley, Cal.

A fluid or unctuous lubricant, consisting of a mineral lubricating substance and compounds of chloride of sulphur with fats or fatty oils.

**461,542.**—Process of making concrete tombstones. Neill C. Cameron, Magnolia, Ark.

**461,550.**—Drying, dessicating and roasting apparatus. Carl Salomon, Brunswick, Germany.

**461,664.**—Construction of apparatus for softening and purifying water. Richard S. Brownlow, Manchester, Eng.

**461,665.**—Process of producing hydrofluosilicic acid. Thomas W. Cappon, Brooklyn, N. Y.

Fluoride of silicon is passed into an aqueous solution containing hydrofluoric acid.

**461,675.**—Process of and apparatus for refining cotton seed oil. William A. Grant, Houston, Tex.

**461,681.**—Process of purifying bromine. Jacob C. Kautz, Mason, W. Va.



The bromine is passed in a gaseous form, before condensing, through a solution of the bromide.

**461,684.**—Process of mashing. Leopold Mandl, Buda-Pesth, Austria-Hungary.

The raw material is introduced into a body of water, heated to not over 100° C., heat is then discontinued, and the mash subjected to air under high pressure for a desired time.

**461,692.** }  
**461,693.** } Concentrators. Bryon Tyson, Washington, D. C.

**461,774.**—Process of making yeast. Akos Von Sigmund and Rudol Genge, Klausenburg, Austria-Hungary.

The yeast is manufactured from starch-containing substances by “treating the raw material with acid, holding the matter under steam pressure until the formation of dextrose is completed, then neutralizing the excess of acid in the mash, adding a second protein-containing mash produced by steaming raw material mixed with acidulated water until it is saccharified, mixing this second mash with the first mash, filtering the entire mash to obtain a clear wort, fermenting the clear wort by an addition of yeast while simultaneously passing clarified or ozonized air through the wort, and finally separating the yeast from the fermented wort.”

**461,783.**—Coffee roaster. Adolphus D. Goodwin, Salem, Va.

**461,789.**—Crushing and grinding mill. James W. Winchell, Springfield, Ohio.

*(Issued October 27th, 1891.)*

**461,823.**—Secondary battery electrode. Justus B. Entz, New York William A. Phillips, Brooklyn, N. Y.

**461,858.**—Secondary battery. Montgomery Waddell and Justus B Entz, New York, N. Y.

**461,888.**—Process of manufacturing artificial stone, etc. George Richardson, Washington, D. C.

**461,889.**—Machine for solidifying concrete mixtures. George Richardson, Washington, D. C.

**461,890.**—Concrete block and method of making the same. George Richardson, Washington, D. C.

**461,893.**—Ore concentrator. Charles E. Seymour, Hurley, Va.

**461,965.**—Galvanic battery. Calvin N. Southern, Chicago, Ill.

**461,973.**—Process of manufacturing compressed cakes of soap. Edward G. Brown, Brooklyn, N. Y.

**461,980.**—Manufacture of enameled brick. Wenzel A. Miksch, Philipsburg, Pa.

A coating of enamel is applied to a green brick, then exposed to a temperature sufficient to simultaneously burn the brick and fuse the enamel, and after cooling the brick, coating its surface with a fusible

**colored** glazing compound of low melting-point and reheating the brick **to** melt the glaze.

**461,982.**—Apparatus for manufacturing gas. Trent T. Prosser and Chas. H. Wilder, Boston, Mass.

**462,021.**—Gas retort furnace. William H. Snow, Holyoke, Mass.

**462,035.**—Furnace for burning garbage. Miles L. Davis, Lancaster, Pa.

**462,085.**—Sulphur candle. Stephen B. Morss, Rahway, N. J.

**462,095.**—Process of extracting juice from sugar scum. August Hamelberg, San Domingo, San Domingo.

The scum previously obtained from cane juice is distributed over the **shredded** or partially pressed canes, and then subjected to another **pressing** operation.

**462,108.**—Ore crusher. Percy R. Shill, East Dulwich, Eng.

**462,118.**—Refrigerating apparatus. Jacob Erney, Philadelphia, Pa.

**462,120.**—Vulcanizer. James Fergus, Philadelphia, Pa.

**462,137.**—Process of revivifying gas purifying agents. Charles W. Jones, Milan, Italy.

**462,161.**—Manufacturing of gas. Trent T. Prosser and Chas. H. Wilder, Boston, Mass. J. F. G.



REGULAR MEETING, December 4, 1891.

The regular meeting of the Society was held in the Law Lecture Room of the University, at 8 P. M., President Geo. F. Barker in the chair.

The minutes of the November meeting were read, amended and accepted.

It was moved that the business of the Annual Meeting, which would now be in order, be deferred until the general meeting, to be held in New York on Dec. 29th and 30th. Carried.

The following members were then elected :

Guy E. Couch, 44 W. Court St., Cincinnati, O.

J. C. Dittrich, 128 E. 54th St., N. Y.

Walter D. Field, 40 S. Portland Ave., Brooklyn, N. Y.

Wm. J. Karslake, 7 Kay St., Newport, R. I.

J. U. Lloyd, E. Norwood, Ohio.

Jas. H. Hyndman, 98 W. 9th St., Cincinnati, O.

Wm. N. Mumper, Hughes High School, Cincinnati, O.

H. T. Nichols, Avondale, Cincinnati, O.

Prof. T. H. Norton, Univ. of Cincinnati, Cincinnati, O.

Prof. L. M. Norton, Mass. Inst. of Technology, Boston.

W. Simonson, 9th and Race Sts., Cincinnati, O.

Dr. Sigmond Waldbott, 150 E. 5th St., Cincinnati, O.

E. C. Wallace, 62 Loth St., Cincinnati, O.

B. D. Westenfelder, Am. Oak Leather Co., Cincinnati, O.

Prof. Chauncy R. Stuntz, Woodward High School, Cincinnati, O.

Earnest Twitchell, 559 W. 7th St., Cincinnati, O.

The following were proposed for membership :

Frank H. Andrews, Providence, R. I.

Lyman C. Newell, Providence, R. I.

Clarence E. Wilson, Providence, R. I.

The following papers were read :

I.—Experimental Chemistry in the 18th Century. Extracts from Unpublished Letters of Joseph Priestley (with exhibition of engraved portraits of contemporaries), by Dr. H. Carrington Bolton.

II.—Apparatus for the Delineation of Curved Surfaces, in illustration of the Properties of Gases, etc., by Dr. Morris Loeb.

III.—A New Burette Holder, by Prof. A. A. Breneman.\*

The resignation of W. T. Lees was read and accepted.

The meeting was then adjourned to the 29th day of December, 1891.

DURAND WOODMAN,  
*Recording Secretary.*

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## EXPERIMENTAL CHEMISTRY IN THE EIGHTEENTH CENTURY.

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BY DR. H. CARRINGTON BOLTON.

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The above title was the subject of an evening lecture before the Society, which, from the nature of it, is unsuited for reproduction here.

A number of letters were read, and portraits of men of science and others, contemporaries of Priestly, were shown. Much of this material has since been published by the author in the form of a book.

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\*Will appear in January number.

## APPARATUS FOR THE DELINEATION OF CURVED SURFACES, IN ILLUSTRATION OF THE PROPERTIES OF GASES, ETC.

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BY MORRIS LOEB, PH.D.

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In attempting the graphic representation of the relations between the volume, temperature and pressure of gases, or of other problems involving three variables, one is met by the difficulty of properly constructing the surfaces in question. Drawing isothermals, etc., as projected upon a single plane, gives a very imperfect idea of the actual proportions. For many years this method has been occasionally supplanted by the actual construction, in papier maché or plaster, of models bounded on one side by the surface in question, relief maps in other words. This plan suffers from several disadvantages. Aside from the notion of solid volume which is involuntary entertained in beholding such a model, some of the surfaces are too complex to be well shown in this manner. Furthermore, the models are rather hard to make, expensive and occupy a good deal of room.

I have obviated most of these difficulties by obtaining a set of glass plates, about 11 cm. square and 7 mm. thick, ruled in squares 7 mm. wide. Placed one on top of the other, these form a block whose perpendicular edge may be taken for the third axis in a system of rectangular co-ordinates. Having drawn upon a sheet of paper the curves representing the relation between volume and pressure at successively  $0^{\circ}$ ,  $10^{\circ}$ ,  $20^{\circ}$ ,  $30^{\circ}$ , etc., of temperature, I can trace them, with suitable grease-chalks, upon the successive glass plates. When these are superposed, the curves exhibit the proper relations in space and afford a very fair idea of the nature of the surface of which they are elements, without arousing any sensation of an included volume. Since the lines can always be erased and replaced by others, a set of twenty plates suffices for all purposes, and the surfaces can be produced at a moment's notice if the necessary sketches on paper are preserved. Besides

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Compiled by A. BOURGOUGNON.

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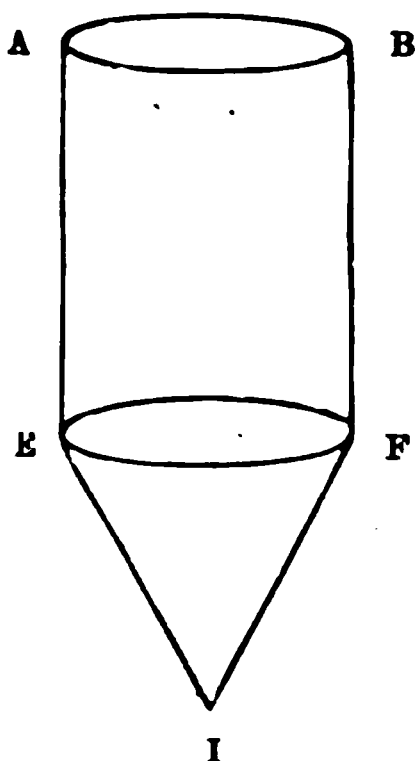
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**460,683.**—Apparatus for testing mine gases. Thomas Shaw, Philadelphia, Pa.

**460,685.**—Apparatus for coating plates with tin. Henry F. Taylor and William B. Struse, Briton Ferry, Eng.

**460,697.**—Hydraulic lime. John H. Wright, Louisville, Ky.

Crude potash, crude soda ash, alum, sulphate of lime and water are combined with unslaked lime.

**460,722.**—Apparatus for washing and separating gold and silver from their ores. William J. Tanner, London, Eng.

**460,732.**—Ore separator. Horace H. Taylor, Fresno, Cal.

**460,733.**—Ore feeder. James Tulloch, Angel's Camp, Cal.

**460,814.**—Concentrator. Gustav Lang, San Francisco, Cal.

**460,842.**—Composition of matter for soles of shoes. George E. Brown and John W. Blackwell, Wrentham, Mass.

A composition of rubber, litharge, whiting, flour of sulphur, lamp black, and a gritty substance.

**460,861.**—Preserving compound. James M. Gillihan and Thomas J. Gillihan, Olathe, Kans.

Nitrate of potassium, sulphur and salicin are the preservatives used.

**460,985.**—Process of making sodium or potassium. Curt Netto, Dresden, Saxony, Germany.

Process for the production of potassium or sodium from their hydroxides in a continuous operation, which consists in bringing the caustic alkali into contact with the reducing carboniferous matter at such a low temperature that only the caustic alkali is reduced to a metallic state, while the alkali carbonate simultaneously formed remains undecomposed

and is withdrawn out of the reach of the reducing carboniferous matter without interruption of the reducing process or the admission of air to the reducing vessel or retort during the reducing operation.

**460,989.**—Process of preparing wort. Carl Rach, Chicago, Ill.

A mash of malt is first made and separated into thin liquid and a thick mash; second, the thick mash is cooked at the boiling point; third, making a mash of natural cereals mixed with a small per cent. of malt and stirred and cooked under pressure; fourth, mixing, cooling and stirring the two thick mashes above referred to; fifth, cooling this mixture and the thin liquid above referred to to about 158° F., and mixing half of the thin liquid with the mash; sixth, letting the mash stand until the erythrodextrine reaction has ceased; seventh, raising the temperature of the remaining thin liquid to boiling point and then mixing it with the mash so as to raise the temperature of the whole to 176° to 178° F.; eighth, drawing off the wort in the ordinary way.

**461,010.**—Process of removing lime from hides. Charles W. Cooper, Brooklyn, N. Y.

The said materials are subjected in a bath of water to carbonic acid gas.

**461,024.**—Composition for electric batteries. Daniel M. Lamb, Boston, Mass.

**461,026.**—Compound for electric batteries and method of preparing the same. D. M. Lamb, Boston, Mass.

**461,034.**—Process of making quick malt. Martin L. Mowrer, Dayton, O.

Malt is soaked in water of a temperature of 100 to 150° F. for a period of about six hours, then slowly drained for about the same length of time, then crushed and dried.

**461,050.**—Crushing machine. Wilhelm Schranz, Laurenburg, Germany.

**461,086.**—Blue azo dye. Gustav Schulz, Berlin, Germany.

Hexa azo dyes derived from one molecule of toluidine or anisidine, one molecule of alpha-naphthylamine, and two molecules of an alpha-naphthol disulpho acid. The dyes are insoluble in alcohol, readily soluble in water and sulphuric acid, and are not readily affected by air and light.

**461,108.**—Process of tanning. Robert W. Turner, Dublin, Tex.

The hides are subjected first to a weak solution and then to a strong solution of an infusion of the plant *Amphiachyris Draconculoides*.

**461,164.**—Process of making fertilizer from stick. Joseph Van Ruymbeke, Chicago, Ill.

The stick is first treated with sulphates in the usual way, then dissolved in sulphuric acid, and then mixing therewith tribasic phosphate of lime and allowing the mass to lie until apparently dry.

**461,235.**—Device for feeding chemicals to filters. Thomas H. Butler, Baltimore, Md.

**461,251.**—Art or method of galvanizing metal. Henry K. Swinscoe, Clinton, Mass.

**461,260.**—Hemp or flax decorticating machine. Augustus E. Ellinwood, Akron, O.

**461,343.**—Method of and apparatus for producing from coal smokeless flame for heating. William A. Koneman, Chicago, Ill.

**461,365.**—Process of preserving timber. James McKeon, Oakland, Cal.

**461,372.**—Jelly extractor. Rose Smith, Grand Rapids, Mich.

**461,394.**—Process of and apparatus for manufacturing gas. James M. Rose, Alleghany, Pa.

*(Issued October 20th, 1891.)*

**461,416.**—Process of obtaining alumina from bauxite. Joseph A. Bradburn and John D. Pennock, Syracuse, N. Y.

The process consists in oxidizing the iron and organic matter by treatment with a hypochlorite and carbonic acid gas, then treating the oxidized bauxite with caustic soda solution, filtering out the liquor, precipitating the hydrate of aluminum, and calcining it.

**416,425.**—Ore concentrator. Frederick M. Endlich, Ouray, Col.

**416,429.**—Mining sulphur. Herman Frasch, Cleveland, Ohio.

The process consists in liquefying the sulphur in the mine by fusion and removing the melted sulphur.

**461,430.**—Apparatus for mining sulphur. Herman Frasch, Cleveland, Ohio.

**461,431.**—Mining sulphur. Herman Frasch, Cleveland, Ohio.

A sulphur solvent is used to remove the sulphur from the underground deposit.

**461,467.**—Composition of matter for insulating purposes. Marcus O. Farrar and Charles C. Howe, Bristol, N. H.

**461,513.**—Lubricant. Adolph Sommer, Berkeley, Cal.

A fluid or unctuous lubricant, consisting of a mineral lubricating substance and compounds of chloride of sulphur with fats or fatty oils.

**461,542.**—Process of making concrete tombstones. Neill C. Cameron, Magnolia, Ark.

**461,550.**—Drying, dessicating and roasting apparatus. Carl Salomon, Brunswick, Germany.

**461,664.**—Construction of apparatus for softening and purifying water. Richard S. Brownlow, Manchester, Eng.

**461,665.**—Process of producing hydrofluosilicic acid. Thomas W. Cappon, Brooklyn, N. Y.

Fluoride of silicon is passed into an aqueous solution containing hydrofluoric acid.

**461,675.**—Process of and apparatus for refining cotton seed oil. William A. Grant, Houston, Tex.

**461,681.**—Process of purifying bromine. Jacob C. Kautz, Mason, W. Va.

The bromine is passed in a gaseous form, before condensing, through a solution of the bromide.

**461,684.**—Process of mashing. Leopold Mandl, Buda-Pesth, Austria-Hungary.

The raw material is introduced into a body of water, heated to not over 100° C., heat is then discontinued, and the mash subjected to air under high pressure for a desired time.

**461,692.** }  
**461,693.** } Concentrators. Bryon Tyson, Washington, D. C.

**461,774.**—Process of making yeast. Akos Von Sigmund and Rudolf Genge, Klausenburg, Austria-Hungary.

The yeast is manufactured from starch-containing substances by “treating the raw material with acid, holding the matter under steam pressure until the formation of dextrose is completed, then neutralizing the excess of acid in the mash, adding a second protein-containing mash produced by steaming raw material mixed with acidulated water until it is saccharified, mixing this second mash with the first mash, filtering the entire mash to obtain a clear wort, fermenting the clear wort by an addition of yeast while simultaneously passing clarified or ozonized air through the wort, and finally separating the yeast from the fermented wort.”

**461,783.**—Coffee roaster. Adolphus D. Goodwin, Salem, Va.

**461,789.**—Crushing and grinding mill. James W. Winchell, Springfield, Ohio.

*(Issued October 27th, 1891.)*

**461,823.**—Secondary battery electrode. Justus B. Entz, New York, William A. Phillips, Brooklyn, N. Y.

**461,858.**—Secondary battery. Montgomery Waddell and Justus B. Entz, New York, N. Y.

**461,888.**—Process of manufacturing artificial stone, etc. George Richardson, Washington, D. C.

**461,889.**—Machine for solidifying concrete mixtures. George Richardson, Washington, D. C.

**461,890.**—Concrete block and method of making the same. George Richardson, Washington, D. C.

**461,893.**—Ore concentrator. Charles E. Seymour, Hurley, Va.

**461,965.**—Galvanic battery. Calvin N. Southern, Chicago, Ill.

**461,973.**—Process of manufacturing compressed cakes of soap. Edward G. Brown, Brooklyn, N. Y.

**461,980.**—Manufacture of enameled brick. Wenzel A. Miksch, Philipsburg, Pa.

A coating of enamel is applied to a green brick, then exposed to a temperature sufficient to simultaneously burn the brick and fuse the enamel, and after cooling the brick, coating its surface with a fusible

colored glazing compound of low melting-point and reheating the brick to melt the glaze.

**461,982.**—Apparatus for manufacturing gas. Trent T. Prosser and Chas. H. Wilder, Boston, Mass.

**462,021.**—Gas retort furnace. William H. Snow, Holyoke, Mass.

**462,035.**—Furnace for burning garbage. Miles L. Davis, Lancaster, Pa.

**462,085.**—Sulphur candle. Stephen B. Morss, Rahway, N. J.

**462,095.**—Process of extracting juice from sugar scum. August Hamelberg, San Domingo, San Domingo.

The scum previously obtained from cane juice is distributed over the shredded or partially pressed canes, and then subjected to another pressing operation.

**462,108.**—Ore crusher. Percy R. Shill, East Dulwich, Eng.

**462,118.**—Refrigerating apparatus. Jacob Erney, Philadelphia, Pa.

**462,120.**—Vulcanizer. James Fergus, Philadelphia, Pa.

**462,187.**—Process of revivifying gas purifying agents. Charles W. Jones, Milan, Italy.

**462,161.**—Manufacturing of gas. Trent T. Prosser and Chas. H. Wilder, Boston, Mass. J. F. G.



REGULAR MEETING, December 4, 1891.

The regular meeting of the Society was held in the Law Lecture Room of the University, at 8 P. M., President Geo. F. Barker in the chair.

The minutes of the November meeting were read, amended and accepted.

It was moved that the business of the Annual Meeting, which would now be in order, be deferred until the general meeting, to be held in New York on Dec. 29th and 30th. Carried.

The following members were then elected :

Guy E. Couch, 44 W. Court St., Cincinnati, O.

J. C. Dittrich, 128 E. 54th St., N. Y.

Walter D. Field, 40 S. Portland Ave., Brooklyn, N. Y.

Wm. J. Karslake, 7 Kay St., Newport, R. I.

J. U. Lloyd, E. Norwood, Ohio.

Jas. H. Hyndman, 98 W. 9th St., Cincinnati, O.

Wm. N. Mumper, Hughes High School, Cincinnati, O.

H. T. Nichols, Avondale, Cincinnati, O.

Prof. T. H. Norton, Univ. of Cincinnati, Cincinnati, O.

Prof. L. M. Norton, Mass. Inst. of Technology, Boston.

W. Simonson, 9th and Race Sts., Cincinnati, O.

Dr. Sigmond Waldbott, 150 E. 5th St., Cincinnati, O.

E. C. Wallace, 62 Loth St., Cincinnati, O.

B. D. Westenfelder, Am. Oak Leather Co., Cincinnati, O.

Prof. Chauncy R. Stuntz, Woodward High School, Cincinnati, O.

Earnest Twitchell, 559 W. 7th St., Cincinnati, O.

The following were proposed for membership :

Frank H. Andrews, Providence, R. I.

Lyman C. Newell, Providence, R. I.

Clarence E. Wilson, Providence, R. I.



The following papers were read :

I.—Experimental Chemistry in the 18th Century. Extracts from Unpublished Letters of Joseph Priestley (with exhibition of engraved portraits of contemporaries), by Dr. H. Carrington Bolton.

II.—Apparatus for the Delineation of Curved Surfaces, in illustration of the Properties of Gases, etc., by Dr. Morris Loeb.

III.—A New Burette Holder, by Prof. A. A. Breneman.\*

The resignation of W. T. Lees was read and accepted.

The meeting was then adjourned to the 29th day of December, 1891.

DURAND WOODMAN,  
*Recording Secretary.*

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## EXPERIMENTAL CHEMISTRY IN THE EIGHTEENTH CENTURY.

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BY DR. H. CARRINGTON BOLTON.

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The above title was the subject of an evening lecture before the Society, which, from the nature of it, is unsuited for reproduction here.

A number of letters were read, and portraits of men of science and others, contemporaries of Priestly, were shown. Much of this material has since been published by the author in the form of a book.

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\*Will appear in January number.

## APPARATUS FOR THE DELINEATION OF CURVED SURFACES, IN ILLUSTRATION OF THE PROPERTIES OF GASES, ETC.

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BY MORRIS LOEB, PH.D.

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In attempting the graphic representation of the relations between the volume, temperature and pressure of gases, or of other problems involving three variables, one is met by the difficulty of properly constructing the surfaces in question. Drawing isothermals, etc., as projected upon a single plane, gives a very imperfect idea of the actual proportions. For many years this method has been occasionally supplanted by the actual construction, in papier maché or plaster, of models bounded on one side by the surface in question, relief maps in other words. This plan suffers from several disadvantages. Aside from the notion of solid volume which is involuntary entertained in beholding such a model, some of the surfaces are too complex to be well shown in this manner. Furthermore, the models are rather hard to make, expensive and occupy a good deal of room.

I have obviated most of these difficulties by obtaining a set of glass plates, about 11 cm. square and 7 mm. thick, ruled in squares 7 mm. wide. Placed one on top of the other, these form a block whose perpendicular edge may be taken for the third axis in a system of rectangular co-ordinates. Having drawn upon a sheet of paper the curves representing the relation between volume and pressure at successively  $0^\circ$ ,  $10^\circ$ ,  $20^\circ$ ,  $30^\circ$ , etc., of temperature, I can trace them, with suitable grease-chalks, upon the successive glass plates. When these are superposed, the curves exhibit the proper relations in space and afford a very fair idea of the nature of the surface of which they are elements, without arousing any sensation of an included volume. Since the lines can always be erased and replaced by others, a set of twenty plates suffices for all purposes, and the surfaces can be produced at a moment's notice if the necessary sketches on paper are preserved. Besides

being useful for illustrating lectures in molecular physics, the plates can also be employed to advantage in the construction of crystallographic, geological and other models.

Where the parallax, inevitable for glass plates, becomes annoying, it is possible to substitute wide-meshed cotton netting, stretched upon square frames of uniform thickness. The curves can be embroidered upon the net, as it were, with pieces of colored thread; although it is not quite so easy to make the lines conform to the drawing, the general effect remains the same.

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## FOURTH GENERAL MEETING.

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Dec. 29th and 30th, 1891.

### FIRST DAY'S SESSION.

The meeting was called to order at 11 A. M. in the chapel of the University of the City of New York, the president, Prof. Geo. F. Barker, in the chair.

Chancellor Henry M. McCracken, of the University of the City of New York, having been introduced by Prof. McMurtrie, the chairman of the Committee of Arrangements, welcomed the society to the University and to the city.

President Barker replied briefly, referring to the contributions which the University had made to science through the work of Morse and the Drapers.

The Secretary announced the various places of interest to be visited after the close of the session; the first being the Columbia College School of Mines (upon the invitation of Prof. Chandler), then the Ehret Brewery, the Works of the Brin Oxygen Process Co., etc.

The following gentlemen were nominated for membership:

E. H. Adams, of N. Y. Tartar Co., 9th St. and Gowanus Canal, Brooklyn, N. Y.

Wm. N. Berkeley, University of Va., Va.

*Corresponding Secretary*, A. C. HALE.

*Recording Secretary*, DURAND WOODMAN.

*Treasurer*, C. F. McKENNA.

*Librarian*, C. E. MUNSELL.

*Curators.*

W. H. KENT, F. VANDERPOOL, A. H. SABIN.

*Committee on Papers and Publications.*

A. C. HALE, A. A. BRENEMAN, J. F. GEISLER.

*Committee on Nominations.*

A. H. SABIN, C. A. DOREMUS,  
A. P. HALLOCK, W. H. KENT,  
LUCIUS PITKIN.

*Board of Directors.*

G. C. CALDWELL, DURAND WOODMAN,  
A. A. BRENEMAN, A. P. HALLOCK,  
E. WALLER, J. H. STEBBINS, JR.,  
A. R. LEEDS, L. H. FRIEDBURG.  
A. C. HALE, WILLIAM McMURTRIE,  
R. W. HALL, J. F. GEISLER,  
C. F. McKENNA.

*Advisory Council.*

F. W. CLARKE, H. W. WILEY,  
ALFRED SPRINGER, G. F. BARKER.

It was moved that the thanks of the Society be given to the local committee for the efficient provision that had been made by them for the convenience and entertainment of the members during attendance at the meeting.

A vote of thanks was also offered to the Chancellor and the authorities of the University for all the courtesies received by the Society at their hands.

It was further moved that the thanks of the Society be tendered to the Ehret Brewing Co., the Mutual Gas Light Co., the Equable Gas Light Co., the Brin Oxygen Co., the De La Verger Refrigerating Co., the Chemical Manufacturers of New York and to all others from whom the Society has received courtesies. Seconded and carried.

The retiring president, Prof. Barker, expressed his sense of pleasing relations that had marked his term of office and congratulated the Society upon the election of his successor.

A motion to adjourn was then made and seconded, and the fourth general meeting was adjourned.

DURAND WOODMAN,  
Recording Secretary

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## ON DISULPHOTETRAPHENYLENE.

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BY C. E. LINEBURGER.

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Since the work of Stenhouse<sup>1</sup> and Graebe<sup>2</sup> on Disulphodiphenylene and its derivatives, no one, so far as I know, has taken up the investigation of the subject, except Friedel and Crafts, who have effected the synthesis of the compound by means of the reaction of the sulphur chloride on benzene in the presence of aluminium chloride. These chemists have not studied the substance further. Still the constitution of the compound seems to be such as to lend itself easily to synthesis, and now that it can be so easily prepared by means of the Friedel-Crafts reaction, nothing prevents its further study. I have therefore tried to carry out some of the reactions of which disulphodiphenylene seemed capable.

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(1) Liebig's Ann., 140, 284 and 156, 332.

(2) Liebig's Ann., 174, 177; 179, 178, and 180, 234.

**Prof. J. S. Cassidy**, Covington, Ky.

**Geo. C. Davis**, B. S., Pottsville, Pa.

**Prof. Chas. T. P. Fennel**, Cincinnati Coll. of Phar., Cinn., O.

**Chas. R. Findley**, Abingdon, Va.

**Paul C. Freer**, Ann Harbor, Mich.

**John G. Hall**, Natrona, Pa.

**D. W. Hoyt**, A. M., High School, Providence, R. I.

**Chas. A. Harper**, Cinn. Univ., Cincinnati, O.

**Otis C. Johnson**, Ann Harbor, Mich.

**Dr. Jos. M. Locke**, 58 W. 3d St., Cincinnati, O.

**Horatio Loomis**, Burlington, Vt.

**Oscar Lowman**, Ph. D.

**W. J. Matheson**, 178 Front St., New York.

**Chas. G. Merrell**, B. S., Mass. Inst. Tech., Boston.

**Dr. S. B. Newberry**, Cornell Univ., Ithaca, N. Y.

**David J. Ogilvy**.

**Pedro J. Sosa**, Panama, Columbia, S. A.

**Prof. G. G. Pond**, State College, Pa.

**Prof. Victor C. Vaughan**, Ann Arbor, Mich.

**Fred. J. Walling**, Smith and Bergen Sts., Brooklyn, N. Y.

**Prof. A. V. E. Young**, Northwestern Univ., Chicago, Ill.

It was moved that the polls for the annual election be closed a half hour after the close of the day's session instead of at five o'clock as announced on the programme. Carried.

The chair called for open nominations if members desired to add to those offered by the Nominating Committee. None were made.

The names of the Committee on Revision of the Constitution were read and on motion a meeting of this committee was called at two o'clock.

Letters were read from Dr. C. A. Goessmann, Dr. J. W. Mallet, Dr. A. B. Prescott, Dr. T. Sterry Hunt, and others regretting their inability to be present.

The following papers were read:

I.—The Post Mortem Diffusion of Arsenic, a result of Embalming, by C. A. Doremus.

II.—On the Composition of Baryto-celestite, by C. W. Volney.

On motion the meeting was then adjourned until ten o'clock Wednesday morning, Dec. 30.

DURAND WOODMAN,  
Recording Secretary.

SECOND DAY'S SESSION.

Wednesday, Dec. 30, 1891.

The meeting was called to order at 10:45 A. M. in the chapel of the University, President G. F. Barker in the chair.

It was announced that a luncheon would be served at one o'clock, through the courtesy of the University authorities.

An invitation was extended by Professors R. Ogden and Chas. A. Doremus to visit the College of the City of New York, and by Professor Leeds to visit the Stevens Institute.

A telegram from Prof. S. W. Johnson was read, regretting his inability to be present.

An invitation was received from Dr. Torrey to visit the U. S. Assay Office.

A letter of regret was read from Prof. Springer, of Cincinnati.

The following papers were read :

I.—On the Advance in Fractional Analysis of Silicates, by F. W. Clarke.

II.—An Alchemical Chart by W. P. Mason.

III.—On Disulphotetraphenylene, by C. E. Lineburger. Read by the secretary in absence of the author.

IV.—On the properties of matter considered as Periodic Functions of the Atomic Weights, by A. R. Leeds.\*

Prof. Breneman suggested that an informal discussion be held in order to test the sense of the meeting in regard to an International Congress of Chemists at Chicago in 1893.

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\*A preliminary notice. The paper is reserved by the author for completion. Will appear in a later number.

The Chair: "A Congressional Commission has, I understand, been appointed and should be coöperated with. Invitations will be issued in the name of the Columbian Exhibition only."

Prof. A. V. E. Young, of Chicago Northwestern University, a member of the Chicago Committee of Chemists already formed to consider the subject, stated that a World's Congress of scientific men had been provided for covering a wide range of scientific interest. Different interests are to have stated times devoted to them during the Columbian Exhibition. The question now is how best to obtain the coöperation of existing organizations, and further, how best to attract people to this congress. The Congresses on Science and Philosophy are set down for the last two weeks in July, 1893.

A discussion then took place as to what action should be taken by the Society.

The polls were closed at twelve o'clock and Prof. J. H. Appleton and Prof. W. L. Dudley were appointed tellers to ascertain the result of the election.

Prof. McMurtrie offered the following resolution :

*Resolved*, That a committee of five be appointed by the chair to arrange for a general meeting of this Society, to be held in Chicago in the Summer of 1893, and to offer the coöperation of the Society to the authorities of the Columbian Exposition in arranging for an International Congress of Chemists and that this committee have power to add to its number. Carried.

At 12:50 an adjournment was taken for luncheon.

At 1:30 the meeting was again called to order.

The chair appointed Messrs. McMurtrie, Chandler, Prescott, Wiley and Munroe, a Committee on General Meeting at Chicago in 1893.

Prof. Caldwell, chairman of the Committee on Revision of the Constitution and By-laws, reported that a copy of the Constitution, Charter and By-laws would be mailed with each copy of the next number of the JOURNAL, and asked an expression of opinion from members as to changes desired.



A letter was read from Prof. Springer suggesting that the Society consider the methods of milk analysis and recommend the adoption of a uniform method.

Prof. McMurtrie moved that the Society endorse the methods of milk analysis adopted by the Association of Official Agricultural Chemists, and urge their adoption by the chemists of the country.

Prof. Loeb moved to lay this motion on the table. Seconded.

Prof. Caldwell thought it unwise to take up the matter of milk analysis in the condition in which it now stands at the hands of the Association of Official Agricultural Chemists. He was able to say, as one of them, that not a great deal of work had been done in this direction.

Prof. Loeb entered a protest against giving any opinion, either by vote or otherwise, favorable to anything about which the majority of the members knew nothing in particular, and objected to the Society, as a body, giving its endorsement to anything.

Dr. Chandler: I agree with Dr. Loeb and think we should end in disaster if we begin to endorse any special methods of analysis.

Prof. Caldwell then offered the following resolution as a substitute for the previous resolutions:

*Resolved*, That it is inexpedient for this Society to take action looking towards the official endorsement of any methods of technical analysis. Seconded and carried.

Prof. Loeb moved that all authors sending papers to the Society be requested to send specimens of all new substances descriptive of such papers to the Society. Carried.

The tellers announced the result of the elections.\*

*President.*

G. C. CALDWELL.

*Vice-Presidents.*

A. A. BRENNEMAN, A. R. LEEDS, E. WALLER.  
EDWARD HART, C. B. DUDLEY, E. S. WOOD.

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\*A second ballot was taken for the election of President, Treasurer, one member of the Board of Directors, and one member of the Advisory Council, with the following results:

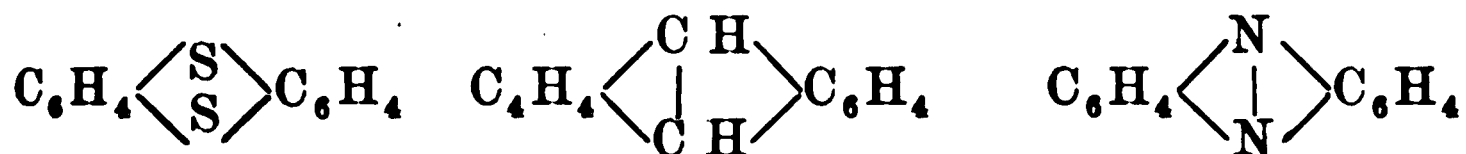
President, G. C. Caldwell.

Treasurer, C. F. McKenna.

Member of board of directors, Wm. McMurtrie.

Member of advisory council, Alfred Springer.

From one point of view, the constitution of disulphodiphenylene much resembles that of anthracene and phenazine:



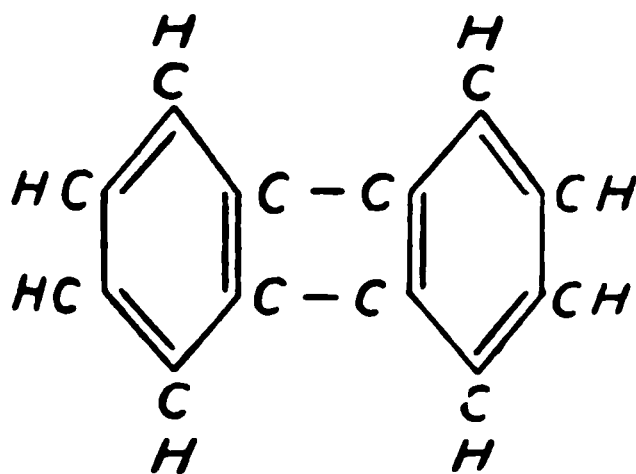
Disulphodiphenylene.

Anthracene.

Phenazine.

It was thought possible to pass, by means of suitable reactions, from one compound to another. I first tried to replace the sulphur atoms in disulphodiphenylene, by the imide group NH. I heated a pure disulphodiphenylene with alcohol saturated with ammonia, in sealed tubes, for more than twenty-four hours at  $280^\circ$ . If the temperature ran higher than  $280^\circ$ , the tubes invariably burst. No reaction, however, took place below  $280^\circ$ , the disulphodiphenylene forming long, finely formed crystals on cooling. The fact that above  $280^\circ$  the tubes burst, no matter whether filled with large or small quantities of substance, indicates that a reaction must have taken place with great violence. As it was impossible to control this reaction, I let dry ammonia act upon boiling disulphodiphenylene. I passed a rapid stream of ammonia into a quantity of disulphodiphenylene which was kept boiling vigorously for several hours. However, not a trace of sulphuretted hydrogen could be found in the ammonia that passed off. The disulphodiphenylene was, indeed, much blackened and gave off a foul odor, but I have found that by prolonged boiling this change always takes place. Disulphodiphenylene decomposes slowly on being distilled; a little black resin always remains in the retort. At any rate, the reaction, if reaction there was, between ammonia and disulphodiphenylene did not take place in the way sought for.

Attempts were then made to form diphenylene by the removal



Diphenylene.

of the sulphur and the union of the carbon atoms. As disulphodiphenylene distils unchanged over freshly reduced copper, it was necessary, in order to bring about a reaction, to pass the vapor of the compound over copper heated to intense redness. Even then a portion of the substance remained unchanged. The stability of the molecules is truly remarkable.

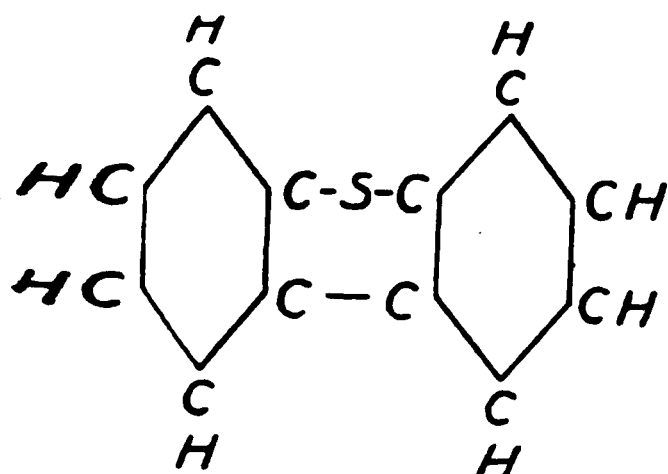
The details of the experiment are as follows: About 10 grm of disulphodiphenylene are put in the bottom of a hard glass tube about twenty mm. in diameter and fifty cm. long, and above this is a plug of asbestos. The rest of the tube is filled in with freshly reduced copper coarsely powdered. The open end of the tube is luted into a flask of about the capacity of a litre in the side of which a small hole is made by means of the blow pipe, that the gases and uncondensed vapors may escape freely. The tube is now laid in a small combustion furnace, placed in slanting position. The copper is first heated as hot as possible and then the disulphodiphenylene *slowly* distilled over it. Quite a decomposition takes place with evolution of ill-smelling fumes. Care must be taken that the orifice in the flask does not become stopped up as the internal pressure will force the lute or blow open the hot tube. A dark colored distillate collects in the flask, where it solidifies on cooling. When all the substance has been distilled over the copper, the flask is disconnected and its contents treated with strong alcohol. After the insoluble resin is filtered off, the filtrate is set aside to crystallize. In a few days a crystalline crust separates out along the sides of the dish. This seems to contain alcohol of crystallization, for, on heating the air-dried substance alcohol is given off. After melting the crystalline crusts to divide off the alcohol, therefore, I dissolved the melt in benzene, in which it is very soluble. On evaporation, irregularly shaped masses of white crystals separated out which did not melt at all well. Evidently we have to do here with a mixture. In experimenting, I found that by sublimation I was able to obtain the greater part of the compound in long white needles. The sublimation takes place at quite a low temperature and the crystal obtained melt very well at  $101^{\circ}$ . As sublimation proved a much better means of purification than crystallization, I made use of it throughout.

An analysis of the sublimate carried out in a bayonet tube with a mixture of copper oxide and lead chromate gave the following results:

	I.	II.	Calc. for $C_{12}H_8S$ .
C .....	77.88	77.97	78.25
H .....	4.35	4.45	4.35

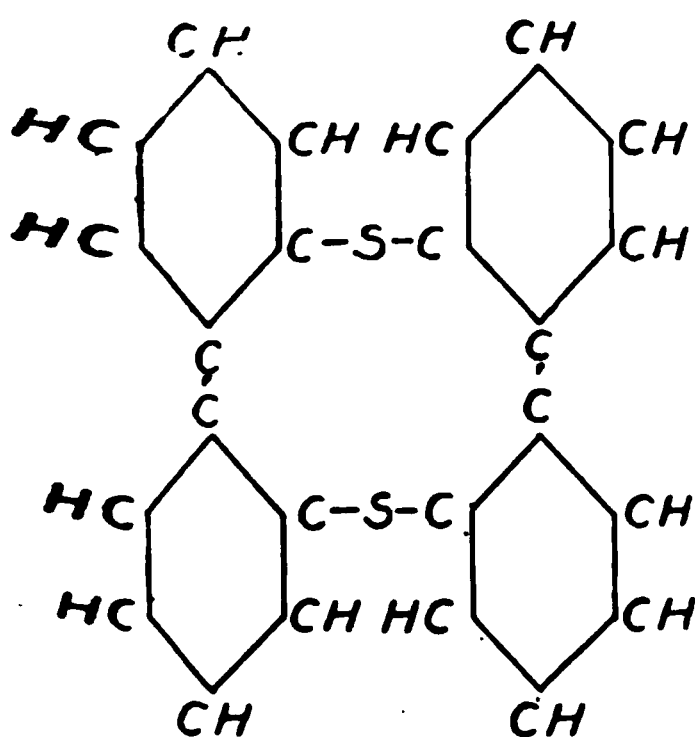
The substance therefore contains sulphur and is not diphenylene.

One would infer from the analysis that it was simply diphenylene



sulphide formed by the removal of an atom of sulphur from the disulphodiphenylene and consequent union of the two bonds thus set free. But its properties differ greatly from those of diphenylene sulphide. Diphenylene sulphide melts at  $94^{\circ}$  (Stenhouse),  $97^{\circ}$  (Graebe), and boils at  $332^{\circ}$ – $333^{\circ}$ . The substance in

question melts at  $101^{\circ}$  and boils at  $414^{\circ}$ , under a pressure of 753 mm. of mercury. The former crystallizes in long needles from strong alcohol; the latter separates out as an indefinite crystalline crust from its alcoholic solution. Also, in their behavior towards oxidizing agents, the two substances differ markedly. By the action of potassium dichromate and dilute sulphuric acid on diphenylene sulphide, diphenylene sulphone  $C_{12}H_8SO_2$ , is formed. The new compound is hardly attacked by the oxidizing mixture, even though heated with it for several hours. These facts establish definitely that the substance obtained, although possessing the same percentage composition, is not diphenylene sulphide. From facts of which I will speak further on I am led to give the substance a formula isomeric with that of diphenylene sulphide having



this constitution. I will call the compound then, from its mode of formation, disulphotetraphenylene.

Disulphotetraphenylene possesses an uncommon stability. All the methods used for estimating the sulphur were inadequate. This fact is in a certain way so noteworthy that I will describe cursorily the experiments carried out for the purpose of determining the sulphur. .1372 grms. of the substance were heated with fuming nitric acid in a sealed tube for six days at  $300$ – $350^{\circ}$ . The tube was of thick glass, such as used by

Berthelot in his experiments on reduction by means of hydriodic acid. Disulphotetraphenylene dissolves easily in cold fuming nitric acid, an oxidation product or a nitro derivative being probably formed. This is so stable, however, that it was not at all destroyed on heating. On opening the tube little pressure was manifest, and on diluting the contents with water, a white organic precipitate was thrown down.

.3024 grms. were placed in a hard glass tube containing potassium nitrate and sodium carbonate, the whole being arranged as recommended by Volhard<sup>3</sup>. But even though the vapor of the substance had to pass through a column nearly 20 cm. long of the fused alkalis kept at an intense heat, the combustion was not perfect, and vapors containing sulphur escaped from the tube.

A combustion tube about a yard long was filled about two-thirds full of dry sodium carbonate; then came a porcelain boat containing the compound, and after the boat a spiral of platinum wire. While a rapid stream of oxygen was passed through the tube, and while the platinum spiral was kept at a high heat, the substance was *slowly* distilled over upon the sodium carbonate. But even though the salt was heated intensely some of the substance passed over unchanged and condensed in the cooler portion of the tube in white needles melting at 101°. However, although I was unable to make a determination of the sulphur in the compound there is no doubt but that it has the composition given above. Being formed in a reducing medium, it would be impossible for oxygen to be present.

Another fact that renders the above constitution very probable is that the two sulphur atoms in disulphodiphenylene are not attached to the molecule with the same force. One may be removed quite easily and by a rather unexpected agent. Disulphodiphenylene dissolves in fuming nitric acid with evolution of reddish fumes even at 0°. If water be added to the solution, a white precipitate is thrown down, which is nothing but diphenylene sulphone. If barium chloride be added to the filtrate from this precipitate, barium sulphate is formed, that is, the filtrate contains

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<sup>3</sup> Liebig's Annalen, 190, 1.

sulphuric acid. The reaction may be interpreted in two ways:

*First.*—The nitric acid removes at once an atom of sulphur from the disulphodiphenylene, and oxidizes it to sulphuric acid, while the bonds of carbon left free unite with each other and the second atom of sulphur is oxidized to the sulphone group.

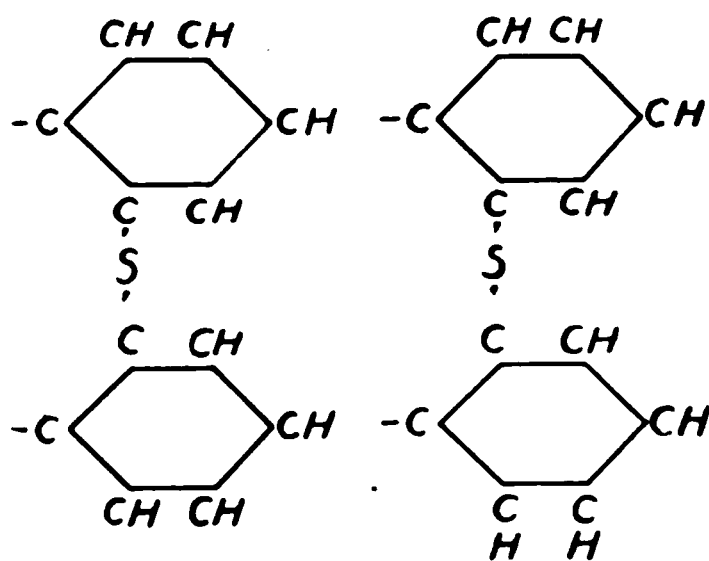
*Second.*—The nitric acid oxidizes immediately the disulphodiphenylene to diphenylene disulphone, which, by further action of the acid, is decomposed into diphenylene sulphone and sulphur dioxide, the latter product being then oxidized to sulphuric acid.

These two interpretations really amount to the same thing. In both cases it is a removal of sulphur from the molecule with union of the bonds thus set free and the oxidation of the remaining sulphur atom. It is rather strange that such a reaction should be brought about by such a reagent as fuming nitric acid; but, at any rate, this explains well the formation of disulphotetraphenylene. The heated copper is able to remove the loosely bound sulphur atom, but the other atom succeeds in escaping its action.

The residues of molecules thus formed seem to prefer to unite two by two, giving disulphotetraphenylene.

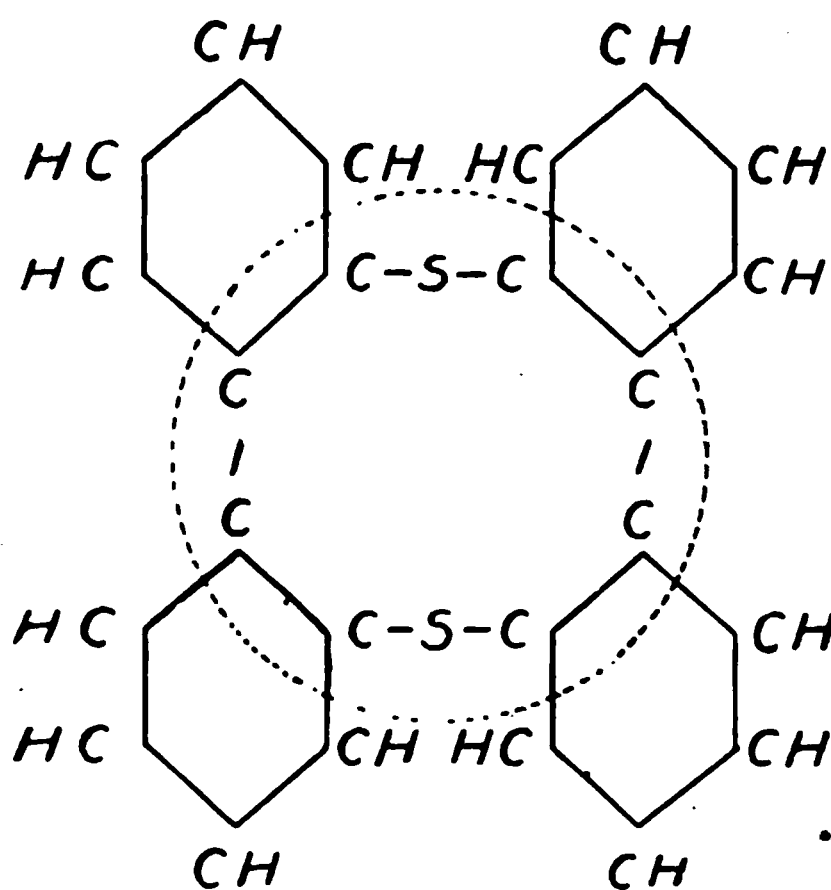
The question arises why, in the reaction of nitric acid on disulphodiphenylene, disulphotetraphenylene or an oxidation product of the same is not formed. The question is a

difficult one to answer. The conditions of the two experiments differ widely. In the one case, we have to do with a strong oxidizing agent at a low temperature, in the other with a powerful reducing agent at a high temperature. This may be the reason that the product of the two reactions are so different. It is, indeed, a little strained to assume that union between free carbon bonds takes place in adjacent molecules rather than in the same molecule. But the fact is that in the reaction of heated copper on disulphodiphenylene, but little, if any, diphenylene sulphide is formed while a comparatively large amount of a



substance with the same percentage composition, but widely different properties, is formed.

Disulphotetraphenylene possesses a ring-like structure, the ring consisting of eight carbon and two sulphur atoms.



A noteworthy fact about this ring is its remarkable stability towards heat. I have not yet obtained a sufficient quantity to make a thorough study of the action of the halogens and oxidizing and reducing agents on it. It is not by any means the only product obtained in the reaction. A quite large quantity of a resin is also obtained. Disulphotetraphenylene is, however, the only compound that I have been able to obtain

in a state of purity. I am engaged in preparing a larger amount of the compound in order to carry out a thorough investigation, the results of which I hope to be able to communicate in the near future.

This work was done in the laboratory of Professor Friedel in Paris.

## THE FRACTIONAL ANALYSIS OF SILICATES.

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BY F. W. CLARKE.

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In the course of some investigations upon the constitution of the natural silicates, it was found that in most cases the empirical formulæ were capable of interpretation in various distinct ways, leading to different structural expressions of equal probability. In some instances there was available evidence by means of which it was possible to choose between alternative formulæ; the final decision resting sometimes upon the association of minerals in nature, and sometimes upon the alterations which they undergo. Such data, however, are not always readily available, and even at their best they only establish presumptions in place of giving satisfactory proof. It became necessary, therefore, to seek for new data of an experimental kind, which should be analogous to the data used by the organic chemist in fixing the constitution of carbon compounds, and by their means to put the problem upon a more satisfactory footing.

Two difficulties were evident from the start. First, the impossibility, in the present state of our knowledge, of measuring the molecular weights of the silicates; and secondly, the lack of plasticity in the material under investigation. The first difficulty is still unsurmountable; but the second is less formidable than it appeared at first, and the experiments presently to be described open up a feasible line of attack upon the outworks of the problem. The results are appearing in detail in a series of mineralogical papers by E. A. Schneider and myself; and only an outline of the chemical methods need be given in this communication. So far, the minerals studied belong mainly to the mica and chlorite groups, with a few other magnesian silicates like talc, serpentine and olivine, as accessories; and it remains to be ascertained whether the methods applicable to these compounds will fit other cases equally well. Theoretically, the outlook is favorable, but difficulties may exist which cannot be foreseen.



Of the minerals heretofore examined, all but one, olivine, contain water. This may represent water of crystallization, acid hydrogen, or hydroxyl in union with basic atoms, and the first problem is to discriminate between these several possibilities. To begin with, the relative stability of the water in each molecule gives a clue to its character; water of crystallization being easily expelled at comparatively low temperatures, and water of constitution being more tenaciously retained. In each case, therefore, the temperature of dehydration was roughly ascertained; every mineral being heated to constant weight first at  $100^{\circ}$ , then at  $250^{\circ}$ – $300^{\circ}$ , and finally at a full red heat. Whenever ferrous iron was present, the total water was also determined directly and so the errors due to possible oxidation during ignition were avoided. Studied in this way the vermiculite micas kerrite, jefferisite, and protovermiculite gave exceedingly suggestive results, each mineral corresponding to an ordinary mica, plus three molecules of water of crystallization, and with the alkaline metals of the original mineral equivalently replaced by hydrogen. Furthermore, the crystalline water fell sharply into two parts; two molecules being expelled at  $100^{\circ}$ , and the third being given off below  $250^{\circ}$ . Thus a mica having the composition  $\text{Al}(\text{SiO}_4)_3\text{Mg}_3\text{KH}_2$  would yield by hydrous alteration a vermiculite represented by the formula  $\text{Al}(\text{SiO}_4)_3\text{Mg}_3\text{H}_3 + 3\text{H}_2\text{O}$ , to which latter compound kerrite approximately corresponds. In the true micas and chlorites the water does not seem to break up into separate fractions upon mere heating, and, being stable up to or near redness, is to be regarded as constitutional.

Up to this point the work done presents no particular novelty, and involves no new modes of procedure. The fractional determinations of water, however, have a direct bearing upon subsequent experiments, and clear the ground for work of a more troublesome kind. Having evidence before us regarding the amount of hydroxyl in a given silicate molecule, the next problem is to determine its distribution and character. It may be united with silicon, representing unreplaced hydrogen of the original silicic acid, it may be combined with magnesium in a univalent group  $\text{—Mg—OH}$ , or it may be linked with aluminum as  $\text{=Al—OH}$  or

$-\text{Al}=(\text{OH})_3$ . In its broadest aspect, the problem is still far from complete solution, but at one point it has been attacked with some success, as follows:

All of the silicates above mentioned as studied by us, except talc, are easily decomposable by aqueous hydrochloric acid. By dry hydrochloric acid gas, however, they are differently affected, and the differences seem to be due to the character of the hydroxyl. Each silicate in turn was weighed out in a platinum boat, and heated to constant weight at a temperature of about  $400^\circ$  in a stream of the thoroughly dried gas. The temperature, it must be noted, is one at which the water of constitution was still retained by the minerals. Olivine, which *contains no hydroxyl*, was practically unattacked, although the aqueous acid decomposes it with great ease. Talc, the true micas, and the vermiculites, were not acted upon, or at most, very trivially. Serpentine and the chlorides, however, were strongly affected; and from them, after the reaction, water extracted considerable amounts of magnesium chloride, in which the magnesia was estimated. In serpentine and ripidolite about one-third of the magnesia was thus removable; or, in other words, the magnesia was separated into two fractions which presumably were differently combined. In these minerals the group  $-\text{Mg}-\text{OH}$  is almost necessarily assumed in any attempt to interpret their structure; and the amount of magnesia taken out as chloride was roughly proportioned to the quantity required by the simplest theory. That is, it seems probable that  $-\text{Mg}-\text{OH}$  in a silicate is converted by dry hydrochloric acid into a chlorhydrin group,  $-\text{MgCl}$ , the latter, by subsequent action of the gas being split off altogether as chloride,  $\text{MgCl}_2$ . This is the simplest explanation of the phenomena; although the nature of the reaction is by no means proved, and a good deal of investigation into it is still necessary. At all events, as regards the magnesian silicates of the groups studied, the new reaction appears to be a legitimate test for  $-\text{Mg}-\text{OH}$ , even though it may not be strictly quantitative. When action takes place, the group is almost certainly present; when there is little or no action, its absence may fairly be assumed.

In the case of talc,  $\text{Mg}_3\text{H}_2\text{Si}_4\text{O}_{12}$ , the foregoing principle finds ready application. For this mineral two constitutional formulæ

have been proposed ; one,  $\text{Mg}_3\text{H}_2(\text{SiO}_3)_4$ , regards it as an acid metasilicate; the other,  $\text{Mg}\left\langle\begin{smallmatrix}\text{Si}_2\text{O}_5-\text{MgOH} \\ \text{Si}_2\text{O}_5-\text{MgOH}\end{smallmatrix}\right\rangle$  represents it as a basic salt of the acid  $\text{H}_2\text{Si}_2\text{O}_5$ . Now talc is practically unattacked by hydrochloric acid either wet or dry, and so a presumption is established in favor of the metasilicate formula. The group  $-\text{Mg}-\text{OH}$  is apparently not present. This view, fortunately, is maintained by other evidence, which also serves to illustrate another principle in fractional analysis.

When talc is sharply and quickly ignited, so as to produce complete dehydration, silica is set free. That silica may then be dissolved out by boiling with an aqueous solution of sodium carbonate, and estimated. One-fourth of the total silica of the mineral was thus liberated, its quantitative determination varying only 0.21 per cent. from the exact amount required. This decomposition represents a splitting up of talc in accordance with the following equation :



which is reconcilable only with the metasilicate formula. If the pyrosilicate formula were correct, the expulsion of water would be indicated thus :



and it is not easy to see how silica could be split off. In short, the separation of the silica into two fractions, and the evidence furnished by the stability of the talc towards acids, prove that the hydrogen of the mineral is acid hydrogen, and establish the constitution of the species. Of all the possible formulæ for talc, the metasilicate formula alone satisfies the experimental conditions.

It has already been stated that the silicates under discussion, with the exception of talc, are readily decomposable by aqueous hydrochloric acid. Upon ignition, however, most of them split up into soluble and insoluble portions, which can be separately investigated. Serpentine, for example, splits up into soluble olivine and insoluble enstatite; water, of course, being eliminated. This particular case of decomposition by heat has

long been known; but among the chlorites and the clintonite micas are found some new applications of the principle. Four examples, closely related, may be cited here, namely, three chlorites of similar type, and xanthophyllite, variety walnewite, from Siberia.

The method of investigation was as follows: Each mineral, of which a sample had been previously analyzed, was strongly ignited in powder over a blast. The operation was performed in a covered platinum crucible, and the ignition lasted for several hours. The material was next digested with strong hydrochloric acid, the mixture was evaporated to dryness, the residue treated with weak acid, and finally filtered off. There remained in the filter, of course, the insoluble portions of the minerals, plus the silica which had been liberated from the soluble parts. This silica was then removed by boiling with sodium carbonate solution, and the undissolved remainder was washed, weighed and separately analyzed. In each of the four cases it proved to have the composition of spinel,  $\text{MgAl}_2\text{O}_4$ , and in quantity it bore a definite relation to the formulæ of the original minerals. The latter were as follows, with their empirical formulæ subjoined:

- A. Ripidolite (clinochlore), from West Chester, Pa.
- B. Clinochlore, from Slatoust, Urals.
- C. Leuchtenbergite, from Slatoust, Urals.
- D. Walnewite, from near Slatoust.

- A.  $\text{Al}_{38}\text{Mg}_{86}\text{H}_{140}(\text{SiO}_4)_{50}\text{O}_{113}$ .
- B.  $\text{Al}_{38}\text{Mg}_{87}\text{H}_{143}(\text{SiO}_4)_{52}\text{O}_{113}$ .
- C.  $\text{Al}_{42}\text{Mg}_{86}\text{H}_{143}(\text{SiO}_4)_{50}\text{O}_{121}$ .
- D.  $\text{Al}_{86}\text{Ca}_{24}\text{Mg}_{52}\text{H}_{50}(\text{SiO}_4)_{28}\text{O}_{174}$ .

Upon dehydration these become:

- A.  $\text{Al}_{38}\text{Mg}_{86}(\text{SiO}_4)_{50}\text{O}_{43}$ .
- B.  $\text{Al}_{38}\text{Mg}_{87}(\text{SiO}_4)_{52}\text{O}_{42}$ .
- C.  $\text{Al}_{42}\text{Mg}_{86}(\text{SiO}_4)_{50}\text{O}_{49}$ .
- D.  $\text{Al}_{86}\text{Mg}_{52}\text{Ca}_{24}(\text{SiO}_4)_{28}\text{O}_{149}$ .

Here we have, throughout, an excess of oxygen over the group  $\text{SiO}_4$ ; and to that excess the amount of spinel formed by ignition is almost quantitatively proportional.

That a decomposition of this sort furnishes strong evidence relative to the constitution of the minerals in question, is clear without argument. Since, however, it is the purpose of the present paper merely to give a brief indication of methods in fractional analysis, an elaborate theoretical discussion would be out of place in it. The data, in all their relations, are being fully considered elsewhere\*, and only a short notice of their bearing is needed here. In the chlorites the group  $\text{—Mg—OH}$  is certainly present; and the three examples here given all reduce to the general formula  $\text{Mg}_2 (\text{SiO}_4)_2 \text{R}'_4$ , in which  $\text{R}'$  is partly  $\text{H}$ , partly  $\text{MgOH}$ , and partly  $\text{AlO}_2\text{H}_2$ . The juxtaposition of the two latter groups serves to explain the formation of spinel upon ignition; while the soluble portions of the decomposed material appear to be mixtures of olivine and magnesian garnet, minerals which are common sources of chlorites in nature. Quite recently, Tschermak has sought to show that these particular chlorites are mixtures of amesite and serpentine. But serpentine, when ignited, yields insoluble enstatite, while the three chlorites studied give only spinel in the residue undissolved by hydrochloric acid. The inference is that the chlorites contain no serpentine molecules, and Tschermak's view becomes untenable.

In the case of the walnewite, the spinel reaction has peculiar interest. In that mineral, the most basic known member of the clintonite group, there is good reason for assuming the existence of a univalent group  $\text{—Al} \begin{smallmatrix} \text{O} \\ \diagup \diagdown \\ \text{O} \end{smallmatrix} \text{Mg}$ , or  $\text{—Mg—O—Al=O}$ , each form of expression having its own theoretical advantages. The walnewite itself appears to be a mixture of isomorphous molecules, among which the compound  $(\text{AlO}_2\text{Mg})_4\text{SiO}_4$  is predominant. Such a compound might easily split up into olivine and spinel,  $\text{Mg}_2\text{SiO}_4 + 2\text{MgAl}_2\text{O}_4$ , and the quantity of spinel actually formed when walnewite is decomposed by heat, is almost exactly the amount required by theory. Two of the groups  $\text{—AlO}_2\text{Mg}$ , coalesce, with removal of one atom of magnesium, to form spinel, while the

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\*Am. Journ. Sci., Oct., Nov., Dec., 1890; Sept. 1891; March, April, 1892.

magnesium thus eliminated goes into the soluble olivine. The fact that the clintonite micas are almost invariably associated with spinel in nature, and frequently also with members of the olivine group, is very suggestive in this connection. The evidence of natural association and the evidence from the laboratory converge to one set of conclusions.

In the light of the foregoing statements the term "fractional analysis" practically defines itself. It is really an attempt at rational, as distinguished from empirical analysis; and it brings into the mineralogical laboratory the methods of the organic chemist. As yet, little more than a beginning has been made, but the field is promising and should yield a rich crop of valuable data. The researches are still in progress; and the results will be made public as rapidly as may be possible.

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## POST-MORTEM DIFFUSION OF ARSENIC, THE RESULT OF EMBALMING.

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CHARLES A. DOREMUS, M. D., PH.D.

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James H. B——, a painter by trade, died on the morning of September 15th, 1891, after an illness, diagnosed by the attending physician as remittent fever.

Two hours after death the undertaker thrust an injecting needle into the abdomen of the deceased and injected a quantity of embalming fluid. The needle passed also above the diaphragm and the fluid was found on the autopsy to partly fill the thorax as well as the abdomen. This fluid contained about 100 grains arsenious oxide and ten grains zinc sulphate to the fluid ounce.

Coroner John Mathews took charge of the case because of rumors of foul play and ordered an autopsy. This was performed September 16th, by Dr. G. A. Lyons, twenty-four hours after the embalming. Parts of the viscera were removed. There was extensive peritonitis and there were pathological conditions that confirmed the

symptoms evidenced before death. The coroner judged, however, and rightly, that it would be wise to remove all doubt concerning alleged arsenical poisoning and the brain and other organs were brought me for toxicological analysis.

One-half the brain, 710 grms., was treated by the potassium chlorate and hydrochloric acid method for the detection of metallic poisons, and two milligrams of arsenious sulphide, equivalent to 1.6 milligrams arsenious oxide, extracted. The presence of arsenic was confirmed by other tests, especially that of Marsh.

The examination was continued and lead, copper and a minute quantity of zinc were also identified by their appropriate tests. The separation of these metals from the arsenic and from each other was quite difficult, and the detection of the zinc was particularly laborious, since the normal earthy phosphates and iron had to be separated, and, in this case, the lead showed a most harassing tendency to pass into analytical groups where it did not belong.

Had arsenic alone been found, a doubt would have at once arisen as to whether it was due to ante-mortem administration or post-mortem diffusion, and zinc was searched for with great care to clear up that point. The non-administration of arsenic in medicine, the very fluid condition of the blood, the injection of the embalming liquid so soon after death, the now well known fact that poisons such as these do diffuse through the tissues, even to parts remote from the point of injection,\* and the absence of arsenic all lead to the conclusion that death was due to disease rather than poisoning.

While no other organs or parts of the body were analyzed it might be possible that arsenic had been absorbed during life along with lead and copper. It is well known, however, that arsenic is rapidly eliminated from the system while lead and copper are not. The man had an illness lasting from ten days to two weeks, during which time he did not work at his trade; any arsenic he might have obtained from such sources would, in all likelihood, have passed from him. The testimony of the attending physician and the history of the findings of the post-mortem agreed very closely,

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\* R. O. Doremus, 1859.

and the jury found a verdict of death due to peritonitis. The jury also took occasion to censure the zeal of undertakers in their over prompt use of embalming agents.

The discussions which arose some years since over post-mortem imbibition of arsenic, have been set at rest in great measure by the experiments made on the diffusion of this substance through the tissues of dead animals and the human cadaver. The brain has been selected as that organ least likely to absorb the poison after death, and therefore to yield the surest evidence of poisoning. The experiments of R. A. Witthaus, published in the *Researches of Loomis' Laboratory*, 1890, p. 38-52, show that arsenic diffuses to the brain when injected in such manner as to prevent its getting there by direct channels.

As previous experiments and papers on this topic are summarized in the article just quoted only a subsequent case is here cited.

Dr. F. A. Durell, Medical Examiner of Somerville, Mass., relates in the *Medical and Surgical Journal*, of Boston, 1890, Vol. **CXXII.**, p. 544, the history of a case where the body was embalmed a few hours after death, and where Dr. Wm. B. Hills found arsenic in the stomach. The undertaker admitted, however, at the inquest, that he had poured some of the arsenical embalming fluid into the mouth, a fact he had previously denied. No analysis of the brain appears to have been made. The prosecution was abandoned. Dr. Durell is emphatic on the point of legislation restraining undertakers from using such measures to preserve the dead.

Since there is no form of murder more difficult to detect, more evasive of the just retribution of the law in the conviction of the criminal, every avenue of possible escape from discovery should be well guarded, and as no more ready means appears to exist to-day for the poisoner to complicate the chemical analysis, if not to render its results wholly valueless, to sow discord among experts and defeat in every way the meting out of justice, than to avail himself of the over zealous attentions of the funeral director, there should be concerted action on the part of all interested in this department of chemistry to form public opinion and secure the enactment of prohibitory laws.

The very speedy diffusion which seems to have taken place in



this particular instance leads me to lay the facts before you, for it shows how even the element of time which might have been a saving clause in favor of the chemist, is taken from him, and demands of us a most outspoken protest against a growing evil, which may frustrate the ends of justice in some cases, in others cause unjust suspicion to rest upon innocent parties.

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## PECULIAR PERFORATION OF ZINC RODS.

BY CHARLES E. MUNROE.

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Through the courtesy of Asst. Eng. B. C. Bryan, U. S. N., of the U. S. Torpedo Boat "Cushing," I received a short time since some fragments of zinc rods which after exposure to the action of hot water in the wing-cylinders of the Cushing's boilers had become perforated throughout their entire length with a central canal.

These boilers are of the Thornycroft pattern and each consists substantially of a horizontal cylinder or "separator," placed in the upper part of the furnace, and two horizontal cylinders placed below in the wings of the furnace, each of these "wing-cylinders" being connected with the separator by a large number of steel "generating" tubes of small diameter which are bent in such shapes and so placed as to form a continuous arch over the grate, and yet spring from the tops of the wing-cylinders and enter the top of the separator. The wing-cylinders are also connected with the separator by means of pipes, known as the "down-comers," which are of larger diameters and have a more direct lead than the generating tubes.

The effect of this arrangement is, that when the boiler is filled with water to its normal level of about half-way up the separator and the fires are started, steam is rapidly generated in the generating tubes from which it rises with the water to the separator, where, by means of baffle plates, separation is effected, the steam passing to the engines and the water descending by the down-

comes to the wing-cylinders, from which it again rises to the generating tubes ; the circulation being thus maintained and its velocity being governed by the area and condition of the fire and the extent of the feed.

As, owing to the disastrous effect of scale in these multitubular boilers, soft water only can be used in them, it is essential to condense the exhausted steam, but as the condenser is made of tinned brass tubes with a copper shell the electro-chemical action between the metals tends to pit and corrode the steel boiler ; hence to prevent this, and also the pitting, which, as I have elsewhere shown,\* may be caused by the action between masses of steel in different physical or chemical conditions, zinc, which is electro-positive to the steel, is put in the boiler in such a way as to be in close metallic contact with it. This practice has long been in vogue for the protection of boilers, but more recently it has come into use for the preservation of the vessels themselves, Mr. Thornycroft, in his "Instructions of March 15, 1889," for the care and preservation of the steel hulls of his torpedo boats, recommending that, in order to protect them from pitting, pieces of zinc be placed on the inside of the vessel at intervals of from 5 to 6 feet apart from stem to stern and as low down as possible, so that they may be immersed in any bilge water present, and so fastened as to be in close metallic contact with the frames of the vessel, the arrangement being made under the supervision of the Naval Chemist.

Usually zinc for boilers is employed in the form of plates which are suspended in the boiler, and this is the form in which it is used in the separator of the Cushing's boiler, but it is introduced into the wing cylinders, which are 14 inches internal diameter by 8 feet in length, in the form of cylindrical rods, 1½ inches in diameter by 5 feet in length, which are squared off for about one inch in length at each end, so as to fit into notches in a steel frame from which they are suspended by their ends in the centre of the wing cylinder. These rods have evidently been cast vertically, and when an unused one is fractured the exposed

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\* *Proc. U. S. Naval Institute* 8, 502 ; 1882.

surface of the interior shows a mass of feather-like fretted crystals radiating in pyramidal groups from the centre, but forming a compact mass, except for an occasional, but non-continuous, small cavity at the centre. The exterior of the rod is of a dull blue color, and appears to have been "chilled" in casting.

The rods, from which the pieces exhibited before you were taken, had been exposed in the boiler for about two months, but the steam was on during this time for but 608 hours, the pressure varying from 50° to 250° pounds, which is equivalent to temperatures of from 137° to 205° C.\* When taken from the boiler, these rods were found to have increased considerably in diameter; to have become oval in form; to be perforated throughout their entire length, with a hole at the centre of somewhat irregular shape, and varying in diameter from  $\frac{1}{16}$  to  $\frac{1}{4}$  inch; to be more or less corroded at intervals on the surface; to be bent down between the points of suspension; and to be so rotten as to easily break under their own weight.

The extent of the increase in diameter is shown from the following measurements of five sections from used rods, the diameter of the unused rod being  $1\frac{3}{4}$  inches.

DIAMETERS.		
	Greatest.	Least.
1st section.....	$1\frac{3}{8}$	$1\frac{3}{8}$ inches.
2d ".....	$1\frac{5}{8}$	$1\frac{3}{8}$ "
3d ".....	$1\frac{5}{8}$	$1\frac{3}{8}$ "
4th ".....	$1\frac{5}{8}$	$1\frac{3}{8}$ "
5th ".....	$1\frac{5}{8}$	$1\frac{3}{8}$ "

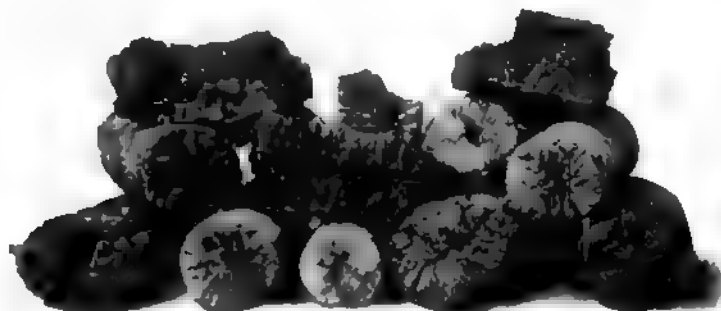
When split longitudinally these sections were found to be filled with radial fissures, and the bundles of feather shaped crystals were coated superficially with oxide.

From consideration of the circumstances I am of the opinion that the formation of the tubular canals in the rods is due to the fact that, as cast, the radiating crystalline mass is held in place by the outer envelope of metal which is produced by the contact of the exterior portion of the molten mass with the cooler walls

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\*J. Perry, *Treatise on Steam*, p. 42, 1874.

of the mould, and that when, through the erosion or corrosion of this envelope by the rapidly circulating heated water, the tension is removed, the crystals are free to move over one another; and that when cooled from the high temperature to which they have attained the bundles of crystals contract along the transverse axis of the rod, away from the centre, and since there is no longer a contracting, continuous exterior envelope to bring them back to their original positions the canals result. The oval form which the rods assume is due to the action of the force of gravitation at the time when the force of attraction of cohesion among the particles of the mass is least. And the action is aided by the fact that the higher limit of temperature which obtains in the boiler is approximately that at which cast zinc becomes quite easily disintegrated.



The appearance of these rods is shown in the cut where A represents a transverse section of an unused rod, and the remainder represent transverse and longitudinal sections of used rods.

I am informed by Lt. Cameron McR. Winslow, U. S. N., commanding the "Cushing," to whose courtesy I am much indebted, that 250 pounds of zinc are used for a single charge in one boiler, and that when the boilers are first run this charge is so completely destroyed in seven days' steaming, that sometimes only small fragments and sometimes no portion whatever of the zinc is found remaining in the boiler at the end of this time. I have had no opportunity of learning what becomes of this mass, as the "Cushing" was put out of commission when my attention was called to the matter.

ON THE COMPOSITION OF BARYTO-CELESTITES.

BY DR. C. W. VOLNEY.

During an examination of minerals, containing barium and strontium, with the view of ascertaining their economical value, I found some interesting coincidences between the results of former observations and my own.

In the silurian limestones of Canada, especially in those of the eastern part of the Province of Ontario, occur considerable deposits of barites and celestites, and although I found some barites of remarkable purity, the greater part of the celestites which came under my observation contain admixtures of barium sulphates in such quantity and regularity that they can hardly be considered accidental.

The barites proper agree in composition and forms of crystallization with those already described. The following gives the analytical results of barites from the County of Renfrew :

H <sub>2</sub> O	0,0040
Ba SO <sub>4</sub>	98,3000
Sr SO <sub>4</sub>	0,0435
Ca SO <sub>4</sub>	0,0104
Al <sub>2</sub> O <sub>3</sub>	0,0015
Fe <sub>2</sub> O <sub>3</sub>	0,0190
Si O <sub>2</sub> (insoluble)	0,0075
“ (soluble)	0,0020
	<hr/> 98,3879

This mineral occurs in solid, white and opaque crystalline masses, with hardly a tinge of coloring in any part of it; orthorhombic, and of rather a tabular character.

The minerals, which were forwarded to me as celestites, were of a fibrous and radiated character, white, opaque, orthorhombic and brittle. Of two samples from deposits in the Counties of Renfrew

and Lanark, the following shows the analytical results; the differences in these two as well as in other cases, are so slight, that they may be safely ascribed to accidents in the analytical work and not to any differences in composition :

H <sub>2</sub> O.....	0,200
Ba SO <sub>4</sub> .....	39,850
Sr SO <sub>4</sub> .....	58,200
Al <sub>2</sub> O <sub>3</sub> } Fe <sub>2</sub> O <sub>3</sub> }	0,100
Ca O.....	0,072
Si O <sub>2</sub> (insoluble).....	0,350
“ (soluble).....	0,150
	<hr/> 98,928

For the purpose of comparing the composition of these minerals with celestites proper from the same localities, I procured a specimen from Frontenac County. This agrees perfectly with the descriptions of the mineral; it is transparent, orthorombic and tabular and considerably harder and less brittle than the above described specimens from Renfrew and Lanark, of the fibrous and radiated character.

An analysis afforded :

H <sub>2</sub> O.....	0,1500
Sr SO <sub>4</sub> .....	96,0000
Ba SO <sub>4</sub> .....	3,7000
Si O <sub>2</sub> (insoluble).....	0,0930
“ (soluble).....	0,0670
Al <sub>2</sub> O <sub>3</sub> .....	0,0430
Fe <sub>2</sub> O <sub>3</sub> .....	0,0570
Mg O.....	0,0025
	<hr/> 100,1125

The mineral gave none of the reactions of lime.

It may be considered as a representative of celestite proper.

Dana<sup>1</sup> notes the occurrence of minerals, which correspond in

<sup>1</sup>System of Mineralogy, 5th ed., 1873; p. 620.

their composition with those from Renfrew and Lanark ; Thompson terms these baryto-celestites and Hugard gives for the angle  $i \wedge i = 103\frac{1}{2}^\circ$ , intermediate between barite and celestite. The mineral analyzed by Thompson came from Drummond Island, Lake Erie, and gave him 61,63 Sr SO<sub>4</sub> and 35,11 Ba SO<sub>4</sub>. Dana says (l. c.) that this analysis needs confirmation. I have, so far, not succeeded in obtaining the mineral from Drummond Island, but the minerals from Renfrew and Lanark seem to confirm Thompson's results and, at all events, justify the terminology, and should be called baryto-celestites.

I will state, in conclusion, that all these minerals were analysed in the following manner : 2 grms. finely pulverized, were first heated in an air bath to a temperature between 150-180°, to ascertain the quantity of water, the remnant melted with potassium-sodium carbonate in the usual way and the mass treated with boiling water. The resulting solution of alkaline sulphates served for determination of the sulphuric acid of the mineral. The earthy carbonates dissolved in hydrochloric acid and precipitated with sulphuric acid, gave the alkaline earth as sulphates, and these were treated with an ammoniacal solution of ammonium carbonate, to separate barium from strontium and calcium. As a means of control, I have, in some cases, determined barium by precipitating it from the solution of the alkaline earths in hydrochloric acid by hydrofluosilicic acid ; it served to ascertain if the change of strontium and calcium sulphates into carbonates had been perfect.

New York, December 21, 1891.

## AN ALCHEMICAL CHART.

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BY PROF. W. P. MASON.

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\* This curious chart, indicating the method of manufacturing gold in twelve steps, is to be found among a number of alchemical writings collected by the French sculptor Chaudet, in 1788. No reference is made to the authorship of the chart, and no written description of the details of the process exists, except the terse and blind latin inscriptions upon its face.\*

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\*This chart represents the supposed production of gold in a series of hermetically sealed flasks. The brilliant coloring of the chart renders it unsuitable for reproduction.—Ed.



## Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

(Issued November 3, 1891.)

**462,229.**—Compound of rosin. George E. Armstrong, New York, N. Y.  
A compound of rosin, vegetable oil and a carbonate of an alkali.

**462,245.**—Reduction of aluminium sulphate to sulphide. Philip A. Emanuel, Aiken, S. C.

Aluminium sulphate is subjected to the action of carbon bisulphide in a closed and highly heated retort; or the sulphate is mixed with sulphur and then subjected to the action of carbon bisulphide in a closed and highly heated retort.

**462,277.**—Pulverizing or reducing mill. John A. Peer, Brooklyn, N. Y.

**462,326.**—Apparatus for treating gold and silver ores. Almarin B. Paul, San Francisco, Cal.

**462,366.**—Process for making caustic soda. James Simpson, Liverpool, England.

The process consists in treating calcium phosphate with hydrochloric acid, adding to this solution sodium sulphate, drawing off the liquor and concentrating the same, subjecting the concentrated mass to a red heat and fusing the same, dissolving the fused mass, separating the sodium phosphate and sodium chloride contained in the solution, treating the sodium phosphate with caustic lime, and separating the calcium phosphate and caustic soda resulting.

**462,414.**—Brown dye. Christian Rudolph, Offenbach, Germany.

A brown basic dyestuff derived from chloride of par diazoacetanilid, metaphenylene-diamine and concentrated muriatic acid. It consists of a black powder easily soluble in water. The aqueous solution is rapidly discolored by zinc dust and muriatic acid and gives a brown precipitate on the addition of caustic soda.

**462,415.**—Blue black azo dye. Christian Rudolph, Offenbach, Germany.

A blue black tetrazo dyestuff derived from tetrazo diphenyl or ditolyl amido-oxy-alphanaphthaline disulpho acid and alpha or beta naphthylamine. Soluble in water with red violet color, and in concentrated sulphuric acid with a blue color.

**462,449.**—Secondary battery. John H. Palmer, Boston, Mass.

**462,585.**—Amalgamating and extracting gold from refractory or other ores. William Crookes, London, England.

The improvement consists in submitting the ore to the combined action of a solution of a mercurial salt and an alternating electric current.

**462,587.**—Water purifier. Easton Devonshire, London, England.

**462,544.**—Bromine compound. Frank H. Fishedick and Charles E. Koechling, New York, N. Y.

**462,551.**—Ice making and refrigerating apparatus. Frederick B. Hill, London, England.

**462,561.**—Gas generator. Arthur Kitson, Philadelphia, Pa.

**462,567.**—Process of making alkaline carbonate and chlorine. Farnham M. Lyte, London, England.

A process for continuously producing "sodic or potassic carbonate and chlorine, which consists in decomposing sodic or potassic nitrate by heating it with calcic carbonate, lixiviating out the sodic carbonate and converting the nitrous fumes evolved into aqueous nitric acid by the action of air or oxygen and water, dissolving plumbic oxide in the nitric acid, precipitating plumbic chloride by means of sodic or potassic chloride, fusing the plumbic chloride and decomposing it electrolytically to form chlorine and metallic lead for use over again."

**462,602.**—Process of purifying iron and steel. Theodore R. Timby, Washington, D. C.

The process for converting or decarburizing and purifying iron consists in introducing mingled jets of animal oil and decomposed or superheated steam into the molten metal.

*(Issued November 10, 1891.)*

**462,678.**—Composition of matter for wall coverings. George W. Abell, Indianapolis, Ind.

Consists of white lead, litharge, sugar, linseed (oil cake) meal, lime, calcined gypsum, sand and water in certain proportions.

**462,693.**—Secondary battery. Nathan H. Edgerton, Philadelphia, Pa.

**462,694.**—Process of purifying tannin solutions by electrolysis. August Foelsing, Dusseldorf, Germany.

**462,730.**—Method of preparing salt for table use. Charles E. Ougley, New York, N. Y.

Damp salt in a powdered or granulated condition is mixed with starch and then exposed to the action of heat for the purpose of softening the starchy granules, and then drying the softened granules upon the salt particles.

**462,824.**—Blue azo dye. Gastav Schultz, Berlin, Germany.

A blue direct dyeing dyestuff obtained by combining one molecule of tetrazo salt substantially such as described with one molecule of alpha-

naphthylamine, again diazotizing the compound and combining with the resultant product two molecules of an alphanaphthol disulpho acid.

**462,904.**—Refrigerating apparatus. Chas. F. Miller, Lancaster, Pa.

**463,058.**—Centrifugal liquid separator. John Laidlaw, Glasgow, Scotland.

**463,062.**—Apparatus for purifying oil. James J. Lowden, Everett, Boston, Mass.

**463,112.**—Process of recovering tin from tin scrap. Hans C. W. Harmesen, Hamburg, Germany.

**463,120.**—Leaching vat for separating metals from their ores. Donald Dennes, Denver, Col.

*(Issued November 17, 1891.)*

**463,139.**—Process for manufacturing gas. Joseph H. Collins, Philadelphia, Pa.

**463,143.**—Process of and apparatus for preparing aluminium sulphide. Philip A. Emanuel, Aiken, S. C.

A special form of apparatus for reducing aluminium sulphate to sulphide by mixing the sulphate with sulphur, heating the mixture and then treating the residual product with carbon bisulphide.

**463,162.**—Crushing machine. Robert McCulley, Philadelphia, Pa.

**463,305.**—Ore separator. William D. Hoffman, Brewster, N. Y.

**463,326.**—Albuminized paper. Arthur Bott, Albany, N. Y.

An improved albuminized paper which consists in first giving the paper a waterproof facing of barium sulphate and then coating it with albumen.

**463,338.**—Continuous evaporating apparatus. Otto Schulz, Buig, Ger-

**463,367.**—Fumigator. William Martin, Glenwood, Cal.

**463,409.**—Apparatus for directing the proper administration of medicine. Edward P. Roberts, Cleveland, Ohio.

**463,421.**—Process of manufacturing sparkling wines. Wilhelm Gerbel, Rohrsbach, Switzerland.

The method consists "in introducing into a closed vessel a ferment and a portion of the wine mixed with the sugar necessary for the fermentation, then separately introducing over this vinous solution of sugar the remaining body of wine and keeping the two from mixing so far as possible, while allowing the carbonic acid evolved from the vinous solution of sugar to rise into and be diffused throughout the body of the wine, and finally drawing off the sparkling wine."

**463,427.**—Metallic alloy. Thomas MacKellar, Philadelphia, Pa.

An alloy of lead, tin, copper, aluminium and antimony.

**463,429.**—Apparatus for obtaining, separating and disinfecting a fertilizer. Metrophane Nadicin, St. Petersburg, Russia.

- 463,466.**—Evaporating apparatus. Edward Theisen, Sinsig, Germany.  
**463,482.**—Ore concentrator. Edw. W. Clark, Butte City, Mont.  
**463,486.**—Process of welding metal electrically. Charles L. Coffin, Detroit, Mich.  
**463,487.**—Electric welding or working of metals. Charles L. Coffin, Detroit, Mich.  
**463,503.**—Device for charging and discharging enameling ovens. Aug. H. Franck, Sheboygan, Wis.  
**463,509.**—Ore sampling device. Robert C. Hawley, Pueblo, Colo.  
**463,514.**—Separator. John F. Keiper, Denver, Colo.  
**463,538 and 463,539.**—Crushing and pulverizing machines. Rob. McCulley, Philadelphia, Pa.  
**463,564.**—Apparatus for the manufacture of sugar sirups. Joseph I. Wilson, Coldwater, Mass.

*(Issued November 24, 1891.)*

- 463,629.** Hydrocarbon burner. William R. Jeavons, Cleveland, Ohio.  
**463,642.**  
**463,643.** } Methods and apparatus for the manufacture of plate glass,  
**463,644.** } cylinders, bottles, etc. Roger S. Pease, Rose, Minn.  
**463,645.** }  
**463,646.** }  
**463,656.**—Churn. Joseph P. Wilson, Glasgow, Ky.  
**463,712.**—Assay furnace. Pierre de P. Ricketts and Edward R. Bush, New York, N. Y.  
**463,731.**—Process of separating cream from milk. John J. Berrigan, Avon, N. Y.  
The process of separating the cream from milk consists in "subjecting the milk while tightly confined to an air pressure of one or more atmospheres above the normal for a limited period of time and subsequently reducing the pressure on the milk to the normal before the cream has all risen."  
**463,757.**—Filter. Omar H. Jewell, Chicago, Ill.  
**463,767.**—Process of making chlorine. Prosper DeWilde and Albert Reyckler, Brussels, Belgium.  
A process for "producing chlorine by first treating with hydrochloric acid gas a mixture of sulphate of magnesium and manganite of magnesia, and, secondly, treating with heated air the thus obtained mixture of sulphate of magnesium, chloride of magnesium, and chloride of manganese."  
**463,769.**—Explosive and process of making the same. James M. Pollard, Washington, D. C.  
An explosive powder composed of finely divided chlorate, nitrate, and sulphur, the particles of each constituent being coated with paraffine.

**468,794.**—Centrifugal separator. Carl G. P. de Loval, Stockholm, Sweden.

**468,799.**—Apparatus for the manufacture of gas. George M. S. Wilson, Toronto, Canada.

**468,800.**—Churn. John H. Brownfield, Moberly, Mo.

**468,823.**—Pulp beater and refining machine. Sharon D. Beach, Seymour, Conn.

**468,841.**—Manufacture of chromates and bichromates. Jules Massignon and Etienne Watel, Paris, France.

Chrome mineral is pulverized, mixed with calcium carbonate and calcium chloride; the mixture then heated to cause the carbonate to be converted into caustic lime and subsequently oxidized. The calcium chloride is then washed out and subsequently the calcium chromate finally precipitated by a lead salt to form lead chromate.

**468,846.**—Apparatus for washing, dyeing and treating textile materials. Ely Sutcliffe and George E. Sutcliffe, Winfield, Eng.

**468,853.** } —Apparatus for burning hydrocarbons. James H. Bullard,  
**468,854.** { Springfield, Mass.

**468,870.**—Calcium light apparatus. George R. Prowse, Montreal, Canada.

**468,875.**—Process of removing free hydrochloric acid from sulphochlorides. Adolph Sommer, Berkeley, Cal.

Air, deprived of its moisture, is passed through the sulphochlorides.

**468,898.**—Blue dye, Albert Hermann, Höchst-on-the-Main, Ger. The sulphonic acids of metaoxy, meta-amido, or alkylized meta-amidotetralkyldiamido-triphenyl carbinols are oxidized with salts of oxide of iron or chromic acid. A copper red powder with metallic lustre, sol. in water, showing intense indigo-blue coloration, insol. in alcohol and benzine, dyeing wool and silk in acid bath in blue shades.

**468,965.**—Process and apparatus for generating gas. William H. Harris, Boston, Mass.

*(Issued December 1, 1891.)*

**464,008.**—Furnace. Thomas E. Caddy, Nottingham, Eng.

**464,020.**—Apparatus for distributing liquids. August Hamelberg, Santo Domingo, S. Domingo.

Apparatus for beer. John Hartin, Boston, Mass.

**464,040.**—Apparatus for generating gas. Adolph Richter, New York, N. Y.

**464,056.**—Process of educing and degumming fibrous material. George E. Armstrong, New York, N. Y.

The disintegrated fibers are treated with a highly resinous saponaceous solution.

**464,088.**—Ore crusher. George Raymond and Albert Raymond, Chicago, Ill.

**464,092.**—Process of destroying Canada thistles. William Burton, Plymouth, Wis.

The thistles are treated with a mixture consisting of naphtha and naphthaline.

**464,096.**—Apparatus for obtaining metal of the alkalies from molten chloride. Ludwig Graban, Hanover, Ger.

**464,097.**—Process of obtaining metallic sodium. Ludwig Graban, Hanover, Ger.

The process of obtaining sodium from its chloride by "combining sodium chloride with another chloride of the metals of the alkalies and with a chloride or chlorides of the metals of the alkaline earths, in the proportion of one molecule of the latter to three molecules of the chlorides of the metals of the alkalies, melting the trisalt and separating the sodium by electrolysis."

**464,103.**—Furnace for wasting ores. Francis O'Brien, Elizabeth, N. J.

**464,104.**—Apparatus for making solutions of bisulphites. Frank J. Peck and James A. Ontterson, Dexter, N. Y.

**464,116.**—Plastering compound. William M. Dawson, St. Louis, Mo.

A composition of matter, consisting of glue, linseed meal and chalk on air slacked lime.

**464,120** —Manufacture of artificial stone. Ludwig Grote, Dresden, Ger.

The process consists in "steeping cellulose in oxide of copper ammonia, freeing the mixture obtained from superfluous liquid, mixing a filling material consisting of magnesium chloride, zinc chloride and magnesite, with the mass and moulding the latter into suitable shapes."

**464,135.**—Blue dye. Meinhard Hoffmann, Frankfort-on-the-Main, Germany.

Blue coloring matters produced by mixing solutions of amidonaphthol-disulpho acid and the tetrazo derivatives of paradiamines and sufficient alkali to keep the solution alkaline. A dark bronze-like powder, easily sol. in water, with a blue color which is not changed by addition of carbonate of soda; insol. in alcohol and ether, sol. in strong sulphuric acid with pure blue shade. The latter solution diluted with water, precipitates the dyestuff in the form of a reddish blue amorphous precipitate.

**464,147.**—Alloy. Alex. W. Cadman, Edgewoodville, Pa.

An anti-friction alloy, composed of antimony, tin, copper and aluminium.

**464,166.**—Evaporating apparatus. William Venuleth, Darmstadt, Ger.

**464,171.**—Furnace for the incineration and destruction of house garbage, etc. Edw. W. Cracknell, Sydney, South Wales.

**464,197.**—Dry air closet. Oscar A. Lanphear, Cincinnati, Ohio.

**464,199.**—Digester for treating paper stock. John MacCormack and Harry L. Van Zile, Albany, N. Y.

**464,236.**—Churn. George P. Withorn, Emporia, Kans.

**464,336.**—Paint. Wells H. Shearer, Arkansas City, Kans.

A waterproof paint consisting of coal tar, pitch, common mineral paint, hydraulic cement, gray ochre, asbestos, air slacked lime, salt, liquid drier and litharge.

**464,351.**—Process of and apparatus for manufacturing copper tubes. Alexander S. Elmore, Leeds, Eng.

**464,367.**—Insulating composition. Smith W. Kimble, Denver, Col.

The composition consists of pulverized mica, silicate of soda, and a mineral substance such as talc free from lime, combined and moulded under pressure.

**464,369.**—Composition of matter for insulating purposes. Smith W. Kimble, Denver, Col.

Composition composed of pulverized mica, silicate of soda, sulphur or sulphur compounds, and another mineral substance such as finely divided asbestos, and molded under high pressure without heat.

**464,389.**—Vacuum evaporating apparatus. Sigismund Pick, Szeza-kowa, Austria, Hungary.

**464,395.**—Method of making alloys. Samuel Singley, New York, N. Y.

“The mode of manufacturing anti-friction alloys, which consists in adding sal-ammoniac to molten lead, agitating the mass and removing the scum, adding a proportionate quantity of antimony, and covering the mass with powdered graphite and then agitating the mass.”

**464,419.**—Fumigator. Stephen P. Bozarth, Wimberly, Tex.

**464,423.**—Process of tanning and dressing leather. Daniel W. Brown, Isaac Clark and James F. Brown, South Fork, Mo.

**464,463.**—Crushing and pulverizing machine. Robert McCully, Philadelphia, Pa.

**464,474.**—Feed water purifier. Michael Egan and Calvin G. Udell, North Indianapolis, Ind.

*(Issued December 8, 1891.)*

**464,509.**—Chemical eraser. Clarence R. Macomber and Ernest V. Scribner, Worcester, Mass.

**464,515.**—Process of manufacturing hydraulic cement. José F. Navarro, New York, N. Y.

“Process of manufacturing Portland cement, which consists in first burning the raw unground rock in a vertical stationary kiln, next pulverizing the burned product, then adding any required additional element, then vitrifying or calcining the pulverized material in a rotating horizontal kiln, and finally pulverizing the product.”

**464,516.**—Process of manufacturing Portland cement. José F. Navarro, New York, N. Y.

To pulverized dry argillaceous rock containing the chemical constituents of Portland cement are added, when deficient in lime, a definite proportion of cement rock high in lime or limestone pure, also ground raw. After thoroughly mixing the dry powders they are burned in a rotating kiln, and finally grinding the resulting clinkers to a powder.

**464,538.**—Violet dye. Arthur Winberg, Frankfort-on-the-Main, Germany.

Solutions of the substituted diamidodiphenylmethanes are mixed with solutions of aromatic monomines, and then oxidizing substances are added to the mixture. A violet coloring matter, tetralkyldisulphobenzyl-diamidotriphenylcarbinol, forming a bronze-like powder easily solvent in water with violet color, which is not changed by dilute alkali, less sol. in alcohol, insol. in ether. Strong sulphuric acid dissolves it with a yellow orange shade. The latter solution when diluted retains the dye-stuff dissolved with a green shade.

**464,543.**—Pocket apparatus for determining the amount of carbonic acid in mixtures of gases. Heinrich Wolpert, Nuremberg, Ger.

"A pocket apparatus for testing carbonic acid in mixtures of gases, consisting of a cylinder provided with a scale indicating the amount of the air at different elevations, and a scale having marks indicating the quality of the gas or air, a piston in said cylinder, and a tube connected with said piston."

**464,566.**—Violet dye. Meinhard Hoffman, Meinken, Ger.

A new coloring matter  $C_{10}H_4(SO_3Na)_2 = [N=N-C_{10}H_4NH_2(a)]_2$ , produced by the action of tetrazonaphthaline beta-disulphonic acid upon alpha-naphthylamine. Easily sol. in hot water with violet color in conc. sulphuric acid with a blackish-blue color, and by reducing agents it is decomposed into diamidonaphthaline beta-disulphonic acid and naphthylinediamine.

**464,642.**—Disintegrating furnace. Frank Walker, Los Angeles, Cal.

**464,669.**—Apparatus for purifying water. William Anderson, Erith, County of Kent, Eng.

**464,672.**—Apparatus for separating gold and silver from ore. William D. Bohn, London, Eng.

**464,695.**—Apparatus for heating with fluid fuel. William A. Koneman, Chicago, Ill.

*(Issued December 8, 1891.)*

**464,700.**—Apparatus for manufacturing fuel gas. William A. Koneman, Chicago, Ill.

**464,717.**—Hydrocarbon burner. Henry Ruppel, Cleveland, Ohio.

**464,719.**—Incandescent lamp filament. Ludwig K. Böhm, New York, N. Y.

Carbonizable material is impregnated with carbonates of calcium or magnesium, and then carbonized, producing a filament of carbon and oxide of calcium or magnesium.

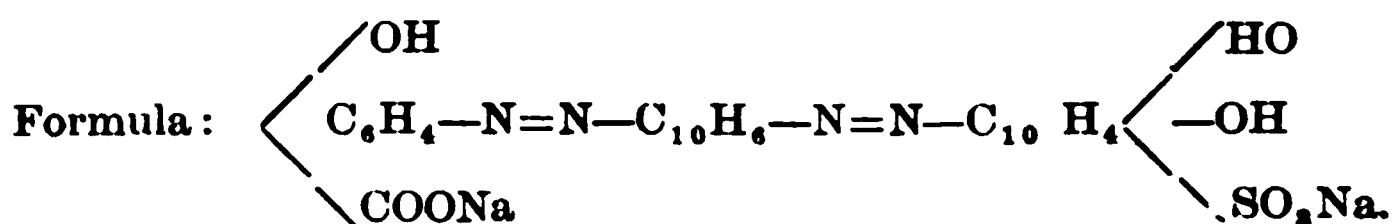


**464,747.**—Retort for making bisulphide of carbon. Joseph Beck, Newark, N. J.

**464,775.**—Blue green azo dye. Richard Lanch and Karl Krekeler, Elberfeld, Germany.

A bluish black powder, difficultly sol. in cold water, more easily sol. in hot water with blue violet color, readily sol. in alkaline solution with almost pure blue color, sol. in conc. sulphuric acid with dark green color, which is altered by addition of water to a pure blue, the dyestuff gradually separating in dark blue flakes. Wool, mordanted with chromium salts, is dyed in bluish green shades very fast against sunlight, soap and milling.

The dyestuff is produced by combining one molecular proportion of the diazo compound of amidonaphthaline azo-salicylic acid with one molecular proportion of dihydroxynaphthaline monosulphonic acid in the presence of sodium acetate.



**464,779.**—Apparatus and method of making fuel gas. Edw. P. Reichhelm, Jersey City, N. J.

**464,782.**—Machine for cleaning vegetable fibre. Manuel Villamor, Meriden, Mex.

**464,800.**—Hemp cleaning machine. William H. Muggeridge, Bellevue, Ky.

**464,815.**—Compound for preparing iron ore for furnace use. Gurdon Conkling, Glen Falls, N. Y.

Compound consists of comminuted iron ore, magnesium chloride, magnesium oxide, calcium oxide, sodium silicate and water.

**464,816.**—Ore separator. Wm. G. Conkling, Glen Falls, N. Y.

**464,850.**—Hydrocarbon burner. Joseph Burns, Fort Plain, N. Y.

**464,861.**—Process of making phenylethylmethylpyrazolone. Gustav Ebert, Höckst-on-the-Main, Germany.

“The process of making phenylethylmethylpyrazolone by heating phenylmethylpyrazolone with iodethyl, then driving off the excess of iodethyl, taking up the free iodine by sulphurous acid, and decomposing the product of the reaction by soda lye; now taking up the oil by benzine, treating with hydrochloric acid, dissolving the hydrochlorate in alcohol, and pouring it into ether, filtering and drying the product, dissolving it again in water, adding soda lye, taking up the oil in benzine, distilling off the latter, and drying the oil remaining back in an exsiccator or by an air pump. Phenylethylmethylpyrazolone is very sol. in water, al-

cohol, benzine, ether and chloroform, insol. or scarcely sol. in ligroine, deliquescent on being left exposed to the air, melting at  $71^{\circ}$  and  $72\frac{1}{2}^{\circ}$  C., having a formula, by analysis, of  $C_{12}H_{14}N_2O$ , forming with sodium nitrite and acetic acid a green, scarcely soluble nitroso compound, and with ferric chloride a red double salt, containing three molecules of the base and two molecules of  $Fe Cl_3$ ."

**464,917.**—Manufacture of Venetian red. Walter J. Wigg, Frodsham, Kingston-upon-Hull, England.

"The process of producing Venetian red, which consists in treating a proper solution of iron and of a body-producing substance with milk of lime or equivalent reagent, agitating and oxidizing the mixture by blowing air or other oxidizing gas or agent through it, further oxidizing and cleansing the precipitate by steam and water, and then furnacing the precipitate."

**464,920.**—Process of manufacturing cast steel. Lewis Cameron, Pittsburgh, Pa.

**464,922.**—Dental vulcanizer. Thomas J. Carrick, Baltimore, Md.

**464,933.**—Process of obtaining metals from their ores or compounds by electrolysis. Charles S. Bradley, Yonkers, N. Y.

**464,934.**—Furnace for the manufacture of gas. Jesse A. Dubbs, Alleghany, Pa.

*(Issued December 15, 1891.)*

**464,963.**—Apparatus for producing gas. Abraham A. Fritz, Brussels, Belgium.

**465,006.**—Cupola furnace. John Walker, Cleveland, Ohio.

**465,031.**—Process of extracting oil. Ernest G. Scott, Port Sunlight, England.

Uses carbon tetrachloride as a solvent for the oils.

**465,077.**—Apparatus for manufacturing heating and illuminating gas. James S. Rogers, Rockport, Mass.

**465,085.**—Apparatus for manufacturing gas. James S. Rogers and James H. Baker, Saratoga Springs, N. Y.

**465,116.**—Brown azo dye. Christian Rudolph, Offenbach-on-the-Main, Germany.

Diazotized toluylenediamine sulpho-acid 1 : 2 : 4 : 6 ( $CH_3 : NH_2 : SO_3H : NH_2$ ) is first combined with two molecules of metaphenylenediamine and the intermediate product further treated with diazotized alpha or beta naphthylamine sulpho-acid. The dyestuff is a blackish powder with a greenish hue, sol. in conc. sulphuric acid with a brown, violet, red color and in water with a brown color.

**465,146.**—Apparatus for the manufacture of gas. Augustin Seguin, Lyons, France.

**465,178.**—Photographic process for printing in colors. Johann C. Hösch, Vienna, Austria-Hungary.

**465,249.**—Fuel produced from lignite. Albert Edelman, Austin, Texas.

**465,250.**—Process of extracting copper pyrites. Thomas A. Edison, Llewellyn Park, N. J.

The method consists "in first concentrating the whole by running or otherwise separating the naturally magnetic material magnetically, then heating the remainder to a temperature sufficient to render the chalco-pyrite magnetic and insufficient to render the iron pyrites magnetic, separating the magnetic chalco-pyrite magnetically. Then reheating the remainder to a much higher temperature to render the iron pyrites magnetic and separating the same magnetically, leaving the gold, silver, lead, etc., as a final non magnetic residue."

**465,280.**—Method of making nitro-cellulose. Hudson Maxim, New York, N. Y.

The process "consists in immersing the material to be nitrated successively in two baths each containing a large excess of mixed nitric and sulphuric acid, in the first and stronger bath of which the cellulose is placed until partially converted into a lower nitro compound, and in the second and weaker of which baths the completion of the conversion into a higher nitro compound takes place, and the acids mixture in the second or last bath being maintained at a suitable working strength by the stronger acids of the first bath adhering to the cellulose material."

**465,314.**—Process of manufacturing steel. William J. Bell, Philadelphia, Pa.

**465,321.**—Apparatus for determining the amount of water in steam. Max Gehre, Roth, Germany.

**465,330.**—Process of manufacturing cement. Calvin Tompkins, New York, N. Y.

Highly heated slag as it comes from the furnace and before it has been allowed to cool, is treated to a bath of hydrat of lime, dried and then pulverized.

**465,349.**—Magnetic ore separator. Clinton M. Ball, Troy, N. Y.

**465,369.**—Production of insulating coatings or linings in electrolytic apparatus. Ludwig Graban, Hanover, Germany.

**465,393.**—Sterilizing apparatus. Marcell von Skotnicki, Charlottenburg, Germany.

**465,398.**—Hydrocarbon vaporiser and burner. Richard Thompson, London, Canada.

*(Issued December 22, 1891.)*

**465,461.**— { Machine for enameling sheet metal.

**465,462.**— { Machine for brushing enamel, etc.

Hubert Claus, Thale-on-the-Harz, Germany.

**465,474.**—Treatment of spent soap lye. Otto C. Hegemann, London, England, and Ebenezer K. Mitting, Chicago, Ill.

**465,525.**—Electrolytic apparatus for treating metals. Edward S. Hayden, Waterbury, Conn.

**465,572.**—Method and apparatus for producing railway ballast from furnace slag. John W. Diebold, Pittsburg, Pa.

**460,582.**—Separating machine. John G. Mundy, Jackson, Mich.

**465,600.**—Process of recovering cyanides from coal gas. William L. Rowland, Philadelphia, Pa.

The process consists in adding a portion of iron salt to the liquor, boiling off the ammonia in the usual manner, and treating the settings with lime to obtain a solution of ferrocyanide of calcium; second, adding an alkaline chloride or sulphate to this solution to form the double salt, the ferrocyanide of calcium and the alkali, and finally decomposing this with an alkaline carbonate to form an alkaline ferrocyanide."

**465,607.**—Manufacture of hydrofluosilicic acid. Marc W. Beylikgy, New York, N. Y.

Ferrous sulphate is first mixed with the equivalent proportion of fine fluor spar, "next heating the said mixture to incipient redness in a close vessel, and causing steam to pass over it to decompose it and produce fluorhydric acid charged with vapor of water and finally passing the said acid condensed with water through silica."

**465,614.**—Compound to restrain the setting of plaster and process of making the same, a composition of quicklime, glue and flour.

**465,646.**—Furnace. John Haggerty, New York, N. Y.

**465,654.**—Combined chlorinating and filtering vessel. Donald Dennes, Deadwood, S. D.

**465,667.**—Crushing and grinding mill. George C. Janney, Springfield, Ohio.

**465,668.**—Vaporizer for hydrocarbon or similar fluids. Wm. J. Kenderline, Philadelphia, Pa.

**465,672.**—Process of making steel. Gustav Lindenthal, Pittsburg, Pa.

**465,703.**—Process of refining petroleum and analagous oils. Chas. C. Mengel, Sr., Bay City, Mich.

The vaporized oils are treated under pressure with carbonic acid gas.

**465,717.** } Compositions for covering steam pipes, etc. Robt. S Miller,

**465,718.** } Wilmington, Del.

**465,735.**—Dental vulcanizing apparatus. George B. Snow, Buffalo, N. Y.

**465,746.**—Hydrocarbon burner. Wm. H. Ames, Easton, Mass.

**465,784.**—Process of polishing sheets of pyroxyline material. Wm. Schmidt, Arlington, N. J.

**465,796.**—Carbonic acid generator. Jacob F. Wittemann, New York, N. Y.

**465,817.**—Petroleum burner. Louis Godder, Winchester, Mass.

**465,822.**—Process of and apparatus for purifying oil. James J. Lowden, Everett, Mass.

*(Issued December 29, 1891.)*

**465,828.**—Compound for carburizing metals. Samuel H. Brown, Boston, Mass.

The compound is composed of "bone-carbon, tungstic acid, calcined lime, soda-ash, and sal-ammoniac."

**465,833.**—Method of ornamenting iron tablets. Joseph Cavalli, London, Eng.

**465,860.**—Ink. Thomas W. Just, Robert Weiler, and Otto Heidepriem, Melbourne, Victoria.

Consists of carbon black, caustic soda, oxalic acid, india ink, vanadium, aleppo galls, nutgalls, gum arabic, aniline dye, with sufficient water to make a freely flowing ink.

**465,871.**—Apparatus for dyeing wool. Samuel Mason, Jr., Manchester, England.

**465,872.**—Process of treating metalliferous ores. Francis H. Molesworth, Adelaide, South Australia.

**465,923.**—Baker's oven. Fritz Dührkop, New York, N. Y.

**465,944.**—Hydrocarbon burner. Edwin G. Murmuery, Detroit Mich.

**465,975.**—Method of vulcanizing and drying wood. Charles Howard, New York, N. Y.

**465,976.**—Soda water apparatus. John Ormesrod, Brooklyn, N. Y.

**465,979.**—Ore concentrating machine. George E. Woodbury, San Francisco, Cal.

**466,045.**—Apparatus for deoxidizing, melting, and puddling iron ores. Henry A. Jones, Brooklyn, N. Y.

**466,047.**—Apparatus for cooling beer. Raymond S. Roswald, New York, N. Y.

**466,138.**—Secondary battery plate. Henry G. Morris and Pedro G. Salom, Philadelphia, Pa.

A compound of sulphide and oxide of lead.

**466,151.**—Process of manufacturing beer and ale. Andrew W. Billings, Brooklyn, N. Y.

"The improvement consists in making a mash by mixing together raw grain and water and a portion of malt, gradually raising the temperature of this mash to the neighborhood of 146° Fahr., then rapidly heating it to between 180° and 212° Fahr., maintaining it at this temperature for a sufficient length of time to disintegrate the outer cuticle and dissolve the starch cells without the formation of empyreumatic products, then cooling it rapidly to below 165° Fhr., then adding the remaining portion of

**malt** required for the brew, maintaining it meanwhile at a temperature of over 155°, the wort being subsequently filtered out and subjected to further operation as in ordinary brewing."

**466,152.**—Percolator. Henry S. Blackmore, Mount Vernon, N. Y.

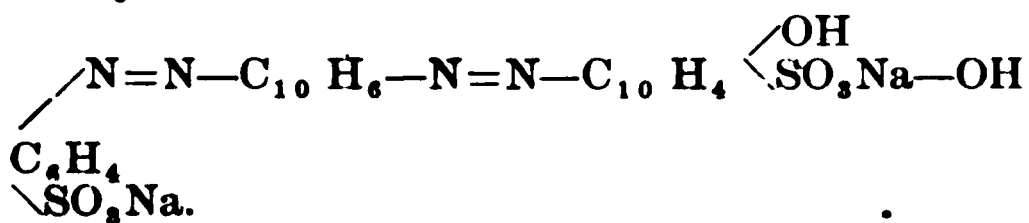
**466,162.**—Grinding and amalgamating mill for gold or silver ores. George Fraser, Auckland, New Zealand.

**466,175.** } Hydraulic presses. Lewis Miller, Philadelphia, Pa.  
**466,176.** }

**466,177.**—Galvanic battery. Samuel Miller, Buxton, Eng.

**466,202.**—Black azo dye. Moritz Ulrich, Elberfeld, Germany.

The dyestuff is slightly sol. in cold water, readily sol. in hot water with deep violet color, also in hot solution of sod. carb. with the same color; by hot soda-lye and by ammonia sol. with intensely blue color; in conc. sulphuric acid with deep green color; which solution on addition of cold water gradually changes to greenish blue, blue, blue violet, and at last separates violet flakes leaving the supernatant liquid colorless. The formula for the dyestuff is



**466,210.**—Apparatus for the manufacture of salt. Reginald C. Wilson, Liverpool, Eng.

**466,223.**—Dyeing apparatus. César Corron, Paris, France.

**466,265.**—Process of and apparatus for making charcoal. Leopold Zwilling, Vienna, Austria-Hungary.

J. F. G.

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# APPENDIX.

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LIST OF OFFICERS,

PAST PRESIDENTS,

HONORARY MEMBERS, MEMBERS AND

ASSOCIATES

OF THE

American Chemical Society,

FOR THE YEAR 1891.



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The Journal

—OF THE—

AMERICAN CHEMICAL SOCIETY.

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VOLUME XIV.

1892.

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*COMMITTEE ON PAPERS AND PUBLICATIONS:*

A. C. HALE,  
J. F. GEISLER.  
A. A. BRENNEMAN, Editor.

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REGULAR MEETING, JANUARY 8th, 1892.

The Regular Meeting of the Society was held Friday evening, **January** 8th, in the Law Lecture Room of the University.

The meeting was called to order at 9 o'clock, Vice President **Breneman** in the chair.

The minutes of the Regular December Meeting were read and **accepted**.

The minutes of the Fourth General Meeting were read, amended, and **accepted**.

The following members were elected :

**E. H. Adams**, N. Y. Tartar Co., 9th street and Gowanus Canal, **Brooklyn**, N. Y.

**Wm. N. Berkely**, Univ. of Virginia, Virginia.

**Prof. J. S. Cassidy**, Covington, Ky.

**Geo. C. Davis**, B. S., Pottsville, Pa.

**Prof. Chas. T. P. Fennell**, Cincinnati College of Pharmacy, **Cincinnati**, O.

**Chas. R. Findley**, Abingdon, Va.

**Paul C. Freer**, Ann Arbor, Mich.

**John G. Hall**, Natrona, Pa.

**D. W. Hoyt**, A. M., Prov. High School, Providence, R. I.

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**Horatio Loomis**, Burlington, Vt.

**Oscar Lowman**, Ph. D., 115 Jefferson avenue, Detroit, Mich.

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**David J. Ogilvie**, Cincinnati, O.

**Pedro J. Sosa**, Panama, Columbia, S. A.



Prof. G. G. Pond, State College, Pa.

Dr. Victor C. Vaughan, Ann Arbor, Mich.

Fred. J. Walling, Smith and Bergen streets, Brooklyn, N. Y.

Prof. A. V. E. Young, N. W. Univ., Chicago.

Wm. Dickoré, Ph. D., Prof. Chemistry Miami Med. College,  
was nominated for membership.

A paper on "The Behavior of Antiseptics towards Salivary Digestion," by H. A. Weber, Ph. D., was read by C. F. McKenna in the absence of the author. After some miscellaneous discussion the meeting was adjourned.

DURAND WOODMAN,  
Recording Secretary.

# REPORT OF THE TREASURER OF THE AMERICAN CHEMICAL SOCIETY.

<i>Resources.</i>		<i>Liabilities.</i>	
Cash in Treasury .....	\$275 84	Subscriptions, Journal .....	\$39 08
Accounts, 1890 .....	254 20	Back numbers Journal .....	12 60
Dues .....	35 00	Dues and Initiation Fees ...	465 13
Personal Accounts .....	166 31	Personal Accounts .....	20 17
		American Chemical Society	194 37
	<u>\$731 35</u>		<u>\$731 35</u>
<i>Gains.</i>		<i>Losses.</i>	
Dues, 1887 .....	\$5 00	Expenses, Journal .....	\$1,018 11
“ 1888 .....	20 00	“ General .....	277 79
“ 1889 .....	36 68	“ Reprints .....	88 95
“ 1890 .....	60 00	“ Wash. Meeting .....	64 05
“ 1891 .....	1,144 87	“ Phila. Meeting	
“ 1892 .....	175 00	(partial)	39 25
Initiation Fees .....	140 00	“ N. Y. Meeting ..	56 28
Subscriptions to Journal ...	114 02	“ Election .....	8 75
Back numbers Journal .....	6 00	“ Binding	
Diagrams .....	15 00	Exchanges	56 65
Advertisements .....	283 75	“ Insurance .....	8 75
Special Subscription, Phila-		Dues .....	16
delphia Meeting .....	44 00	American Chemical Socie-	
Interest .....	5 97	ty .....	431 55
	<u>\$2,050 29</u>		<u>\$2,050 29</u>
<i>Cash Receipts.</i>		<i>Cash Disbursements.</i>	
Cash on hand Dec. 31st,		Cash on hand Dec. 31st,	
1890 .....	\$95 25	1891, and paid to Treasurer	\$275 84
Interest received during		Binding Exchanges .....	56 65
year .....	5 97	Insurance .....	8 75
Back numbers Journal .....	6 00	Subscriptions, New York	
Subscriptions, New York		Meeting paid to Treasurer	
Meeting .....	75 00	of Fund .....	75 00
Dues .....	1,423 59	Accounts, 1890 .....	254 20
Initiation Fees .....	140 00	Election expense (partial) ..	8 75
Subscriptions, proposed din-		Subscriptions, proposed din-	
ner in February, 1891 ....	35 00	ner in February, 1891, re-	
Sundries .....	496 16	turned .....	35 00
		Sundries .....	1,562 78
	<u>\$2,276 97</u>		<u>\$2,276 97</u>

FRANK T. KING, *Treasurer.*

Brooklyn, N. Y., Dec. 31st, 1891.

# ON THE BEHAVIOR OF ANTISEPTICS TOWARD SALIVARY DIGESTION.

BY H. A. WEBER,

Prof. Agr. Chem. Ohio State University, Columbus, O.

Among the various causes which injuriously affect public health perhaps none has received less supervision in this country than the practice of food adulteration. A systematic examination of the food commodities as found upon the market reveals a condition of affairs which is simply appalling to one interested in public welfare. The investigations on this subject show conclusively, that nearly all classes of manufactured or prepared articles of food are liable to be found adulterated.

In many cases, it is true, the adulteration is merely fraudulent and not injurious to health, but, on the other hand, a mass of evidence has accumulated to show that for the sake of gain or of advantage over a competitor, the sophisticator of human food will not shrink from employing such means as endanger the health, or even the life, of the consumer.

One class of food adulterations which has been universally employed of late, without restriction, embraces the use of antiseptics for preserving perishable articles of food. This subject is of especial interest at the present time because the practice of employing various antiseptics as food preservatives is not confined to the manufacturer and dealer, but has found its way into private households all over the land, and because the baneful effects of this practice are not fully appreciated or understood by the public. In general only such antiseptics can be employed as are devoid of an appreciable taste and odor and not immediately injurious in their action upon the consumer. Among these substances may be mentioned salicylic acid, boracic acid, borax, calcium sulphite and saccharine.

That saccharine will doubtless come into general use in food and drink may readily be inferred from its extreme sweetness and its antiseptic properties.

The market is full of preparations which contain boracic or salicylic acid or both, and which are sold as lard bleachers, sausage and meat preservatives, fruit, cider and wine preservatives, &c.

A few of these articles, which the writer has examined, may be mentioned here for the sake of illustration.

1. A lard bleacher called "snow white," containing 10.86 per cent. of boracic acid, and 47.12 per cent. borax.

2. A salt, colored pink with cochineal, called B. Savaline, and used as a sausage and meat preservative, containing 16.26 per cent. boracic acid.

3. A sample of anti-ferment for keeping cider sweet, consisting of  
 Boracic acid ..... 21.6 per cent.  
 Salicylic " ..... 78.4 "

4. Three preservative salts for meat containing respectively, 31.91, 43.05 and 53.22 per cent. boracic acid.

5. A preparation claimed to be harmless, for meats and other foods, containing :

Boracic acid .....	25 per cent.
Saltpetre .....	45 "
Salt .....	30 "

After H. Leffman and W. Beam (Analyst, Vol. 13, page 103), had shown, that certain antiseptics completely arrested the conversion of starch into grape sugar by diastase and pancreatic extract, the writer naturally inferred that a similar effect would be produced by these substances on the diastatic action of saliva.

At my suggestion, Mr. C. T. Fox, one of my students, took up the matter as a subject for his graduating thesis.

The results of his careful and painstaking work are embodied in part in the following tables.

The method employed was as follows :

1 gram of starch was mixed with 10 c. c. of water, and boiled five minutes; 5 c. c. more of water was added, the liquid was cooled to 40° C., 5 c. c. saliva of the same temperature was added, the mixture was violently shaken and kept at the temperature of 40° C. for the required time, when the action of the saliva was suddenly stopped by heating to the boiling point. The mixture was then neutralized, diluted to 100 c. c. and the sugar was de-

terminated by Fehling's solution. At each step parallel tests were made with one gram of pure starch and with one gram of starch containing the indicated amount of preservative, using equal amounts of the same saliva in each case. The preservatives employed were : salicylic acid, boracic acid, calcium sulphite and saccharine.

In the subjoined tables of results (a) represents the amount of sugar obtained from the pure starch, and (b) that obtained from the starch mixed with the varying amounts of the preservatives.

In each step the starch was subjected to the action of the saliva for different lengths of time, viz : 1, 5, 15, 30 and 60 minutes.

TABLE I.

Starch .....	100 grams.
Salicylic acid .....	1 gram.
1 part preservative to 2,100 parts food.	
Time, 1 minute; grape sugar .....	{ a. 7.75 per cent. b. 9.61 "
Time, 5 minutes; grape sugar .....	{ a. 9.61 " b. 10.80 "
Time, 15 minutes; grape sugar ..	{ a. 22.77 " b. 20.83 "
Time, 30 minutes; grape sugar .....	{ a. 26.31 " b. 27.77 "
Time, 1 hour; grape sugar .....	{ a. 27.67 " b. 33.33 "

TABLE II.

Starch .....	100 grams.
Borax .....	1 gram.
1 part preservative to 2,100 parts food.	
Time, 1 minute; grape sugar .....	{ a. 12.82 per cent. b. 9.10 "
Time, 5 minutes; grape sugar .....	{ a. 20.83 " b. 14.70 "
Time, 15 minutes; grape sugar .....	{ a. 28.15 " b. 13.51 "
Time, 30 minutes; grape sugar .....	{ a. 25.00 " b. 16.66 "
Time, 1 hour; grape sugar .....	{ a. 35.04 " b. 27.38 "

TABLE III.

Starch .....	100 grams.
Calcium sulphite .....	1 gram.
1 part preservative to 2,100 parts food.	
Time, 1 minute; grape sugar .....	{ a. 12.82 per cent. b. 14.70 "
Time, 5 minutes; grape sugar .....	{ a. 20.83 " b. 17.86 "
Time, 15 minutes; grape sugar .....	{ a. 28.15 " b. 22.56 "
Time, 30 minutes; grape sugar .....	{ a. 25.00 " b. 20.83 "
Time, 1 hour; grape sugar .....	{ a. b.

TABLE IV.

Starch .....	100 grams.
Saccharine .....	1 gram.
1 part preservative to 2,100 parts food.	
Time, 1 minute; grape sugar .....	{ a. 12.82 per cent. b. 19.20 "
Time, 5 minutes; grape sugar .....	{ a. 20.83 " b. 30.06 "
Time, 15 minutes; grape sugar .....	{ a. 28.15 " b. 25.51 "
Time, 30 minutes; grape sugar .....	{ a. 25.00 " b. 23.80 "
Time, 1 hour; grape sugar .....	{ a. 35.04 " b. 25.51 "

TABLE V.

Starch .....	50 grams.
Salicylic acid .....	1 gram.
1 part preservative to 1,050 parts food.	
Time, 1 minute; grape sugar .....	{ a. 10.62 per cent. b. 10.86 "
Time, 5 minutes; grape sugar .....	{ a. 33.83 " b. 27.70 "
Time, 15 minutes; grape sugar .....	{ a. 33.01 " b. 38.40 "

TABLE V.—*Continued.*

Time, 30 minutes; grape sugar .....	{ a. 34.48 per cent.
	{ b. 34.48 “
Time, 1 hour; grape sugar .....	{ a. 41.66 “
	{ b. 41.66 “

TABLE VI.

Starch .....	50 grams.
Borax .....	1 gram.

1 part preservative to 1,050 parts food.

Time, 1 minute; grape sugar .....	{ a. 10.62 per cent.
	{ b. 13.90 “
Time, 5 minutes; grape sugar .....	{ a. 33.33 “
	{ b. 14.28 “
Time, 15 minutes; grape sugar .....	{ a. 33.01 “
	{ b. 18.51 “
Time, 30 minutes; grape sugar .....	{ a. 34.48 “
	{ b. 27.77 “
Time, 1 hour; grape sugar .....	{ a. 41.66 “
	{ b. 29.41 “

TABLE VII.

Starch .....	50 grams.
Calcium sulphite .....	1 gram.

1 part preservative to 1,050 parts food.

Time, 1 minute; grape sugar .....	{ a. 10.62 per cent.
	{ b. 10.41 “
Time, 5 minutes; grape sugar .....	{ a. 33.33 “
	{ b. 28.40 “
Time, 15 minutes; grape sugar .....	{ a. 33.01 “
	{ b. 26.29 “
Time, 30 minutes; grape sugar .....	{ a. 34.48 “
	{ b. 38.46 “
Time, 1 hour; grape sugar .....	{ a. 41.66 “
	{ b. 30.71 “

TABLE VIII.

Starch .....	50 grams.
Saccharine .....	1 gram.
1 part preservative to 1,050 parts food.	
Time, 1 minute; grape sugar .....	{ a. 10.62 per cent. b. 12.50 "
Time, 5 minutes grape sugar .....	{ a. 33.33 " b. 35.71 "
Time, 15 minutes; grape sugar .....	{ a. 33.01 " b. 35.71 "
Time, 30 minutes; grape sugar .....	{ a. 34.48 " b. 34.40 "
Time, 1 hour; grape sugar .....	{ a. 41.66 " b. 40.32 "

TABLE IX.

Starch .....	40 grams.
Salicylic acid .....	1 gram.
1 part preservative to 840 parts food.	
Time, 1 minute; grape sugar .....	{ a. 16.66 per cent. b. 2.84 "
Time, 5 minutes; grape sugar .....	{ a. 20.00 " b. 3.52 "
Time, 15 minutes; grape sugar .....	{ a. 26.31 " b. 14.28 "
Time, 30 minutes; grape sugar .....	{ a. 31.25 " b. 23.80 "
Time, 1 hour; grape sugar .....	{ a. 38.45 " b. 35.71 "

TABLE X.

Starch .....	40 grams.
Borax .....	1 gram.
1 part preservative to 840 parts food.	
Time, 1 minute; grape sugar .....	{ a. 16.66 per cent. b. 4.46 "
Time, 5 minutes; grape sugar .....	{ a. 20.00 " b. 8.33 "



TABLE X.—Continued.

Time, 15 minutes; grape sugar.....	{ a. 26.31 per cent.
	{ b. 19.22 “
Time, 30 minutes; grape sugar.....	{ a. 31.25 “
	{ b. 27.27 “
Time, 1 hour; grape sugar.....	{ a. 38.45 “
	{ b. 33.34 “

TABLE XI.

Starch.....	40 grams.
Calcium sulphite.....	1 gram.
1 part preservative to 840 parts food.	
Time, 1 minute; grape sugar.....	{ a. 16.66 per cent.
	{ b. 12.19 “
Time, 5 minutes; grape sugar.....	{ a. 20.00 “
	{ b. 22.72 “
Time, 15 minutes; grape sugar.....	{ a. 26.37 “
	{ b. 29.35 “
Time, 30 minutes; grape sugar.....	{ a. 37.25 “
	{ b. 33.33 “
Time, 1 hour; grape sugar.....	{ a. 38.45 “
	{ b. 38.40 “

TABLE XII.

Starch.....	40 grams.
Saccharine.....	1 gram.
1 part preservative to 840 parts food.	
Time, 1 minute; grape sugar.....	{ a. 16.66 per cent.
	{ b. 22.72 “
Time, 5 minutes; grape sugar.....	{ a. 20.00 “
	{ b. 29.41 “
Time, 15 minutes; grape sugar.....	{ a. 36.31 “
	{ b. 35.71 “
Time, 30 minutes; grape sugar.....	{ a. 31.25 “
	{ b. 35.71 “
Time, 1 hour; grape sugar.....	{ a. 38.45 “
	{ b. 41.66 “

TABLE XIII.

Starch .....	20 grams.
Salicylic acid .....	1 gram.
1 part preservative to 420 parts food.	
Time, 1 minute; grape sugar .....	{ a. 7.14 per cent. b. None.
Time, 5 minutes; grape sugar .....	{ a. 20.83    " b. None.
Time, 15 minutes; grape sugar .....	{ a. 26.31    " b. None.
Time, 30 minutes; grape sugar .....	{ a. 30.00    " b. None.
Time, 1' hour; grape sugar .....	{ a. 36.76    " b. None.

TABLE XIV.

Starch .....	20 grams.
Borax .....	1 gram.
1 part preservative to 420 parts food.	
Time, 1 minute; grape sugar .....	{ a. 7.14 per cent. b. Trace.
Time, 5 minutes; grape sugar .....	{ a. 20.83    " b. 10.00    "
Time, 15 minutes; grape sugar .....	{ a. 26.31    " b. 13.88    "
Time, 30 minutes; grape sugar .....	{ a. 30.00    " b. 29.23    "
Time, 1 hour; grape sugar .....	{ a. 36.76    " b. 31.22    "

TABLE XV.

Starch .....	40 grams.
Calcium sulphite .....	1 gram.
1 part preservative to 420 parts food.	
Time, 1 minute; grape sugar .....	{ a. 7.14 per cent. b. 7.81    "
Time, 5 minutes; grape sugar .....	{ a. 20.83    " b. 28.73    "

TABLE XV.—*Continued.*

Time, 15 minutes; grape sugar.....	{ a. 26.31 per cent. b. 27.78 “
Time, 30 minutes; grape sugar.....	{ a. 30.00 “ b. 35.71 “
Time, 1 hour; grape sugar.....	{ a. 36.76 “ b. 35.71 “

TABLE XVI.

Starch.....	20 grams.
Saccharine.....	1 gram.
1 part preservative to 420 parts food.	
Time, 1 minute; grape sugar.....	{ a. 7.14 per cent. b. None.
Time, 5 minutes; grape sugar.....	{ a. 20.83 “ b. None.
Time, 15 minutes; grape sugar.....	{ a. 26.31 “ b. None.
Time, 30 minutes; grape sugar.....	{ a. 30.00 “ b. None.
Time, 1 hour; grape sugar.....	{ a. 36.76 “ b. None.

TABLE XVII.

Starch.....	10 grams.
Salicylic acid.....	1 gram.
1 part preservative to 210 parts food.	
Time, 1 minute; grape sugar.....	{ a. 19.83 per cent. b. None.
Time, 5 minutes; grape sugar.....	{ a. 12.82 “ b. None.
Time, 15 minutes; grape sugar.....	{ a. 21.30 “ b. None.
Time, 30 minutes; grape sugar.....	{ a. 33.35 “ b. None.
Time, 1 hour; grape sugar.....	{ a. 38.45 “ b. None.

TABLE XVIII.

Starch .....	10 grams.
Borax .....	1 gram.
1 part preservative to 210 parts food.	
Time, 1 minute; grape sugar .....	{ a. 19.83 per cent. b. None.
Time, 5 minutes; grape sugar .....	{ a. 12.82 per cent. b. Trace.
Time, 15 minutes; grape sugar .....	{ a. 21.30 per cent. b. 8.92 " "
Time, 30 minutes; grape sugar .....	{ a. 33.35 per cent. b. 17.85 " "
Time, 1 hour; grape sugar .....	{ a. 38.45 " " b. 29.41 " "

TABLE XIX.

Starch .....	10 grams.
Calcium sulphite .....	1 gram.
1 part preservative to 210 parts food.	
Time, 1 minute; grape sugar .....	{ a. 19.83 per cent. b. Trace.
Time, 5 minutes; grape sugar .....	{ a. 12.82 per cent. b. Trace.
Time, 15 minutes; grape sugar .....	{ a. 21.30 per cent. b. 22.72 " "
Time, 30 minutes; grape sugar .....	{ a. 33.35 " " b. 31.25 " "
Time, 1 hour; grape sugar .....	{ a. 38.45 " " b. 31.25 " "

TABLE XX.

Starch .....	10 grams.
Saccharine .....	1 gram.
1 part preservative to 210 parts food.	
Time, 1 minute; grape sugar .....	{ a. 19.83 per cent. b. None.
Time, 5 minutes; grape sugar .....	{ a. 12.82 per cent. b. None.

TABLE XX.—*Continued.*

Time, 15 minutes; grape sugar.....	{ a. 21.30 per cent. b. None.
Time, 30 minutes; grape sugar.....	{ a. 33.35 per cent. b. None.
Time, 1 hour; grape sugar.....	{ a. 38.45 per cent. b. None.

From the inspection of the tables it will be seen, that when the preservatives were present in the proportion of one part to 210 parts of the food mixture the diastatic action of the saliva was completely arrested, *in each case* for the periods of one minute and five minutes. For the other periods of time the calcium sulphite was without effect, borax retarded the action to the end, while in the case of salicylic acid and saccharine not a trace of sugar was formed even in the one hour period.

When the amount of the preservatives employed equalled 1 part to 420 parts of the food mixture not a trace of sugar was formed, even in the one hour period, in the case of salicylic acid and saccharine. Borax completely arrested the diastatic action for the remaining periods up to the hour period. In this proportion calcium sulphite was without effect.

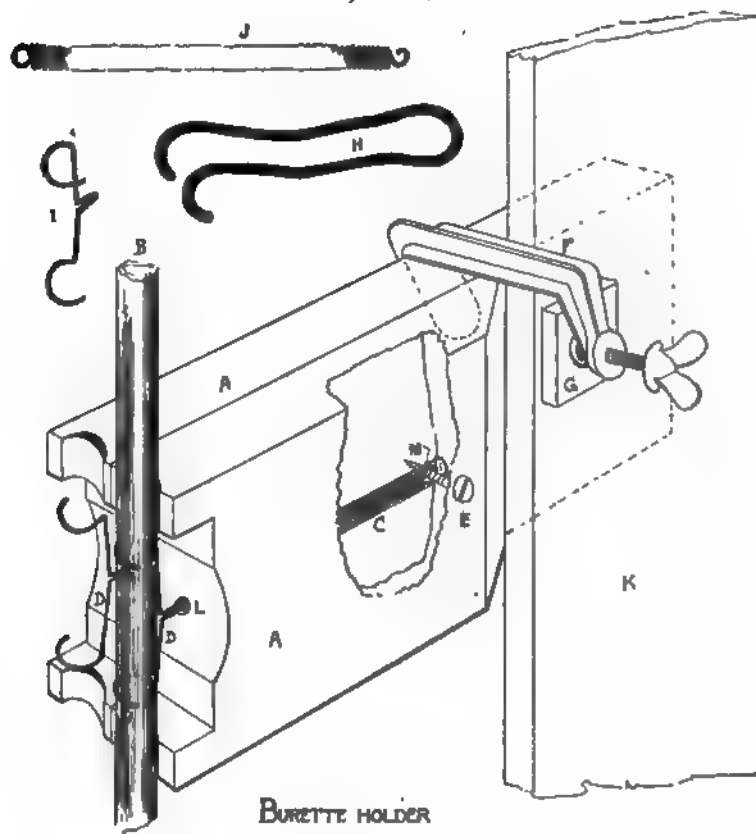
Where the proportion of the preservative was 1 to 840 parts of the food mixture, salicylic acid almost stopped the action of saliva for the periods of one and five minutes and appreciably retarded it for the remaining periods. Borax had a very depressing effect for the one, five and fifteen minutes periods with less marked results in the thirty and sixty minutes periods. Calcium sulphite and saccharine were without effect.

Where the proportion was one of preservative to 1050 of food mixture borax alone showed a depressing effect. The results with borax are also shown to be similar to the last, when the preservative present amounted to only 1 part in 2100 parts of the food mixture.

## AN IMPROVED BURETTE HOLDER.\*

By A. A. BRENNEMAN.

The burette holder shown in the cut is a modified form of one that I have seen, but of which I do not know the origin. The original features of the present one are the use of a spiral spring much longer than in the original holder, imbedded in a wooden block which can be clamped at will to the upright part of any laboratory shelf, thus dispensing with a stand and leaving the table clear, while not interfering with the use of the shelf, and of the combination of two holders in one, as shown in the cut.



\*Read at the regular meeting, December 4, 1891.

The springs C, J, which are 10–12 cm. long, are made of hard brass wire of about 8 mm. diameter, coiled as closely as possible. One end M, terminating in a closed loop is sunk into a deep longitudinal hole L, parallel with the axis of the block. The loop is held firmly by a screw which passes through it from the outside. The spring, when not extended, reaches within 1 c.m. of the opening. The stirrup I, is connected with it by its middle loop and is then held so as to support even a very small tube within its rings by drawing the tube against the jaws of the block.

The grooves are faced with cork, first glued in place and then shaped with a round file. These are afterwards well rubbed with melted paraffine as is also the entire surface of the wooden block, thus affording protection against acid or caustic solutions. The wire portions are lacquered, or better, plated with platinum. The rings of the stirrup are bent to an arc of about  $250^{\circ}$ . The entire block is 23 cm. long, 10 cm. wide, and 5 cm. thick. The beveled portion is 15 x 10 x 2.5 cm.

The large double hook H, is an indispensable part of the holder. Introduced at the side of the stirrup, opposite the opening of the rings, it is used to draw the stirrup forward for the removal or insertion of a burette.

The readiness with which burettes can be moved up or down, or rotated, with a single movement and with one hand, is a marked advantage of this holder. The superiority of wire over silk or catgut, sometimes used in burette stands, will be apparent, and the clearness of view afforded, as compared with the use of the usual burette clamp, is another advantage.

The holder is held in place against the upright part of the shelf by a common iron clamp F, readily obtained of any hardware dealer. A small block of wood G, 3x3x1 cm., with a hole running partly through it, serves as a socket for the end of the screw to prevent defacing of the shelf to which the holder is attached.

## Abstracts of American Patents Relating to Chemistry.

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*(From the U. S. Patent Office Gazette.)*

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*January 5, 1892.*

**466,323.**—Process of manufacturing water gas. Walton Clark, Philadelphia, Pa.

**466,325.**—Method of enameling sheet metal ware. Hubert Claus, Thale-in-the Harz, Germany.

The process consists in “coating the article with a groundwork of enamel; second, treating the surface thus coated with a repellent solution of ammonium sulphate and epsom salts; third, coating the article with a coarsely ground gray enamel and finally glazing or coating the article with a thin paste of translucent enamel.”

**466,441 and 466,442.**—Apparatus and process for hardening steel. George F. Simonds, Fitchburg, Mass.

**466,452.**—Process of reducing oxides of iron. Thomas S. Blair, Jr. Allegheny, Pittsburg, Pa.

The heated oxides are subjected to a current of a reducing gas heated to the temperature of the ore when at a red heat. The reduced sponge is then subjected to a current of a cold non-oxidizing gas until sufficiently cool to prevent oxidation when exposed to the atmosphere.

**466,455.**—Method of forming alloys. Sherwood E. Chusman, Kansas City, Mo.

The method consists in “precipitating copper from a solution of its sulphate, adding mercury, and then an insoluble arsenite suspended in alkali liquid to the amalgam, followed by the addition of the metal with which, in addition to copper, it is desired to form an alloy, and subsequently removing the mercury.

**466,460.**—Art of electrolytic decomposition. Thomas A. Edison, Menlo Park, N. J.

Substances not readily decomposed at a low temperature are confined in a suitable vessel and heated sufficiently to vaporize the material and cause pressure in the vessel, thus raising the temperature above the boiling point of the liquid. An electric current is then passed through the highly heated substance.



**466,483.**—Transfer copying compound. Ernest Asmy, Milwaukee, Wis.

A preparation compounded of glycerine, gum arabic, isinglass, ammonia, oil, alcohol and wax.

**466,484.**—Centrifugal liquid separator. Clemens Von Bechtolsheim, Stockholm, Sweden.

**466,495.**—Process of separating nickel from its ores. Henri L. Heuenschmidt, Petit-Querilly, France.

**466,498.**—Hydrocarbon burner. John A. Lannert and William R. Jeavons, Cleveland, Ohio.

**466,513.** )

**466,514.** )

**466,515.** )

—Ore separators. Charles J. Reed, Orange, N. J.

**466,524.**—Method of preserving corpses. Graham H. Hamrick, Philippi, W. Va.

A cavity of the body is opened and treated to a solution of saltpetre and then the entire body subjected to the fumes of burning sulphur in a suitable chamber.

**466,534.**—Art of preparing and transferring photographic and other designs for engraving. William J. Charlton, Providence, R. I.

**466,557.**—Process of duplicating typewritten work. Albert B. Dick, Chicago, Ill.

**466,579.**—Process of and apparatus for treating garbage. Charles F. Simonin and Isaac M. Simonin, Philadelphia, Pa.

**466,603.**—Gas producer. Charles Fiesse, New York, N. Y.

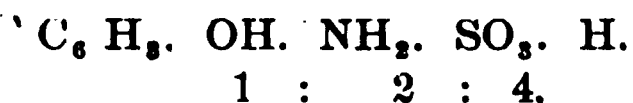
**466,632.**—Apparatus for refining sugar in loaf form. Carl Steffer, Vienna, Austria, Hungary.

**466,664.**—Electric Battery. Patrick B. Delaney, South Orange, N. J.

**466,676.**—Brick kiln. John B. Griswold, Zanesville, Ohio.

**466,707.**—Process of preparing phenol sulphonates of oxychinoline. Josef. Ziegler, Bieberich, Germany.

The process consists in "the production of ortho-oxychinoline by digesting ortho-amidophenol-parasulphonic acid,



with ortho-nitrophenol-parasulphonic acid and with glycerine and sulphuric acid, precipitating from the product of the reaction, by means of soda, the oxychinoline formed, and purifying the same and heating the oxychinoline so obtained with ortho- or para-phenol sulphonic acid in molecular proportions until the combination of the two bodies is complete.

**466,708.**—Process of preparing oxychinoline sulphate. Josef Ziegler, Bieberich, Germany.

**466,709.**—Process of purifying water. Joseph A. Bradburn, Edward N. Trump, and John D. Pennock, Syracuse, N. Y.

The sulphates are precipitated with barium bicarbonate and the carbonates by milk of lime, thus removing the scale forming substances.

**466,720.**—Process of obtaining insoluble chlorides by electrolysis. Stanley C. C. Currie, Philadelphia, Pa.

The method of producing insoluble chlorides direct from the metals consists in constituting the metal or metals to be converted into a chloride or chlorides, the anode in an electrolytic cell in a neutral chloride solution, and then converting the metals into an insoluble chloride or chlorides.

**466,758.**—Ore slimer. Edgar A. Hockley, Ouray, Ohio.

*January 12, 1892.*

**466,782.**—Plastering composition. Arthur L. Grant, Toronto, Canada.

A composition of sodium or potassium oleate united with lime, suitable for mixture with plastering compositions.

**466,820.**—Battery-zinc and method of making the same. John Beattie, Jr., Fall River, Mass.

An amalgam of zinc, mercury, and magnesium. Divided zinc and mercury are subjected to the action of a solution of sulphuric acid and water until partial amalgamation takes place. The liquid is then drawn off and the metal heated until it melts, after which a quantity of magnesium is added and the whole cast into blocks or strips; a number of these are then added to pure molten zinc and then cast into the required form.

**466,826.**—Blue red dye. Edward Hepp, Bieberich-on-the-Rhine, Germany.

A red crystalline compound represented by the formula  $C_{28}H_{16}N_8(SO_3H)_8$ , being the red basic coloring matter termed "phenyl-rosinduline." With concentrated sulphuric acid it gives a strong green solution. It is easily soluble in cold water, but completely insoluble in sulphuric or hydrochloric acid diluted with about the same quantity of water. Its potassium, sodium and ammonium salts are crystalline and very soluble in cold water, are precipitated from aqueous solutions by means of common salt and impart red-bluish shades to wool.

**466,841.**—Red azo dye. Moritz Ulrich, Elberfeld, Germany.

The azo dye which results in combining molecular proportions of toluidine sulpho acid after diazotation and of the dihydroxynaphthaline monosulphonic acid described in patent No. 444,679. The dye in a dry state is a gray-violet amorphous powder, is easily soluble in water with bluish-red, exquisitely clear and pure in color. Readily sol. in soda-lye and ammonia with red color, while in conc. sulphuric acid it gives a deep bluish-violet colored solution.

**466,852.**—Disulpho-acid of phenyl-rosinduline. Edward Hepp, Bieberich-on-the-Rhine, Germany.

**466,881.**—Ore feeder. John R. Russell, San Francisco Cal.

**466,882.**—Rotary ore roaster. Julius E. Shettle, Salt Lake City, Utah.

**466,900.**—Absorbent of nitro-glycerine. Lewis Brown, Landing, N. J.  
Absorbent is a mixture of nitrate of soda, wood pulp, glue and magnesia.

**466,913.**—Carbonate of guaiacol and creosol. Bueno R. Seiffert, Rodebeul, Germany.

A colorless crystalline powder, insoluble in water and soluble in alcohol and ether.

**466,927.**—Process of manufacturing steel. Henry C. S. Dyer, Westhope, England.

The process consists in "charging scrap or pig iron and scrap along with carbon in the form of coke or charcoal or other carbonaceous matter into a basic lined open-hearth furnace, then melting the metal in the charge and finally boiling down the charge with iron ore until the metal contains the percentage of carbon desired."

**466,982.**—Apparatus for disintegrating vegetable substances. John MacCormack and Harry L. Van Zile, Albany, N. Y.

**467,041.**—Method and apparatus for the manufacture of lead fibre. Norman K. Morris, Denver, Colo.

**467,042.**—Method of and apparatus for producing lead carbonate. Norman K. Morris and John W. Bailey, Denver, Colo.

**467,090.**—Method of transferring designs to glass, porcelain or other surfaces. Albert E. Frank and Edward H. Hoad, Pittsburg, Pa.

Paper is first coated with a soluble surfacing or glaze, then with a less soluble surfacing or glaze, the designs are printed on said coated surface, applied directly to the surface to be decorated, and moistened to permit removal of the paper.

**467,140.**—Alloy. Edward C. Miller, East Orange, N. J.

An anti-friction metal consisting of lead, eighty parts; antimony, fifteen parts; tin, five parts.

**467,142.**—Chemical fire extinguisher. William F. Singer, Carthage, N. Y.

*January 19th, 1892.*

**467,147.**—Process of manufacturing steel. Thomas S. Blair, Jr., Allegheny, Pa.

**467,158.**—Apparatus for treating ores. John D. Coplen, Denver, Colo.

**467,162.**—Tetrazo dye. Carl Duisberg, Elberfeld, Germany.

A direct dyeing tetrazo dyestuff made by "combining with one molecular proportion of dianisidine after its diazotation, one molecular proportion of beta-naphthol disulpho acid R, and then one molecular proportion of alpha-naphthol alpha-monosulphonic acid (Neville-Winther.)

A blackish brown amorphous powder with copper like lustre, sparingly sol. in cold water, more readily, with greenish blue color, in hot water; in solutions of the fixed alkalies it dissolves with bluish-red, but in ammonia

with reddish violet and in conc. sulphuric acid with greenish blue color, from which latter solution dark blue flakes separate on the addition of large quantities of water. Mineral acid causes a blue precipitate in the aqueous solution of the dyestuff.

**467,167.**—Disinfecting apparatus. Albert C. Haven, West Bay City, Mich.

**467,169.**—Filament for incandescent electric lamps. Philip Hickley, Evanston, Ill.

A filament of the carbonized root of the *Oryza sativa* or rice plant.

**467,170.**—Concrete mixing machine. Wright S. Hotchkins, Wichita, Kans.

**467,171.**—Process of chloridizing ores of precious metals. Charles A. Hoyt, Butte City, Mont.

**467,200.**—Process of treating leather. Frederick Riegert, St. Joseph, Mo.

Process of rendering leather pliable and waterproof; consists in first drying the cleaned leather, then applying dissolved rubber or Brazilian gum in a liquid state to the heated leather, then applying oil thereto and finally rubbing powdered soapstone to the leather thus treated.

**467,233.**—Process of electric metal working. Hermann Lemp, Lynn, and Walter S. Moody, Chelsea, Mass.

**467,239.**—Battery zinc. Charles B. Schoenmehl, Waterbury, Conn.

**467,240.**—Electric battery. Charles B. Schoenmehl, Waterbury, Conn.

**467,264.**—Method of purifying smoke. Albert Raymond, Chicago, Ill.

**467,266.**—Process of manufacturing gas. John H. Springfellow, London, England.

**467,302.**—Mixing machine for asphalt. John B. Pitchford, San Francisco and Augustus S. Cooper, Santa Barbara, Cal.

**467,308.**—Method of producing ferments. Ludwig Meyer, Stuttgart, Germany.

**467,312.**—Apparatus for separating gluten from slaughter house washings. Edward J. Pope, Eau Claire, Wis.

**467,329.**—Alloy. William J. Miles, Jr., Terre Haute, Ind.

A non oxidizing alloy composed of osmium, iron or steel, tungsten, nickel and aluminium.

**467,356.**—Enameling. Carl F. Pauls, Chicago, Ill.

**467,361.**—Process of treating powdery iron ore. Joel Wilson, Dover, N.J.

**467,368.**—Mill for crushing ores. William H. Coward, Bath, Eng.

**467,372.**—Galvanic battery. Fernand Gardson, Bordeaux, France.

**467,378.**—Art of manufacturing linoleum. Thomas Mitchell, London, Eng.

**467,413.**—Heating and puddling furnace. Owen Hughes, Cleveland, Ohio.

**467,430.**—Mash distilling apparatus. Wilhelm Paulzow, Revel, Russia.

**467,484.**—Electrolytical process and apparatus. Otto Stahlmann, Anaconda, Mont.

*January 26th, 1892.*

**467,492.**—Material for manufacturing paving blocks. Noble T. Barnes, Buffalo, N. Y.

**467,493.**—Method and apparatus for treating Yucca fiber. John C. Best and George W. Anderson, Raytown, Mo.

**467,520.**—Composition of matter for insulating purposes. David H. Piffard, Piffard, N. Y.

Compounded of rubber 5 parts, rosin 24 parts, and plaster of paris (or its equivalent) 26 parts.

**467,548-44-45-46-47.**—Apparatus for charging secondary batteries. Cyprien O. Mailloux, New York, N. Y.

**467,569.**—Ore concentrator. George J. Parker and Charley B. Walker, Trinidad, Colo.

**467,575.**—Disinfecting device. Alexander S. Force, Jersey City, N. J.

**467,605.**—Process of and apparatus for purifying gas. Frederick Bredel, Milwaukee, Wis.

**467,641.**—Process for preserving fruit. Maggie Marshfield, Chicago, Ill.

The process consists in steaming the fruit over sirup containing flavoring extract and allowing the drippings from the fruit to fall into the sirup, and when the fruit is thoroughly cooked and the sirup evaporated to the proper consistency adding the fruit to the sirup while both are hot.

**467,645.**—Magnetic separator. Francis H. Richards, Hartford, Conn.

**467,673.**—Carbonic acid gas generator. Patrick J. McGuire, Salem, Mass.

**467,745.**—Smoke consumer. David C. Adams, Toronto, Canada.

**467,747.**—Malt kiln. John F. Dornfeld, Watertown, Wis.

**467,757.**—Method of preparing and bottling wines. George W. Sessions, New York, N. Y.

**467,800.**—Process of tinning plate. James Gould, Jr., Maywood, Ill.

**467,801.**—Tinning. James Gould, Jr., Maywood, Ill.

**467,833.**—Magnetic separator. Francis H. Richards, Hartford, Conn.

**467,890.**—Duplicating stenciling material. William G. Fuerth, Newark, N. J.

J. F. G.

REGULAR MEETING, February 5th, 1892.

The regular meeting of the Society was called to order at 9 P. M. in the Law Lecture room of the University, Vice-President Breneman in the chair.

The minutes of the January meeting were read and accepted.

The following nominations were made:

Theodore Breyer, 159 Front st., N. Y.

Thos. Lynton Briggs, 357 Madison st., Brooklyn, N. Y.

Prof. Edw. D. Campbell, Ann Arbor, Mich.

Prof. Delos Fall, Ann Arbor, Mich.

Mr. A. G. C. Hahn, 64 Perry st., N. Y.

George O. Higley, Ann Arbor, Mich.

Jesse Jones, 94 Buena Vista st., Allegheny, Pa.

Lyman F. Kebler, Ann Arbor, Mich.

Prof. W. B. Lindsay, Carlisle, Pa.

C. E. Lineburger, North Division High School, Chicago, Ill.

Prof. Frederick G. Navy, Ann Arbor, Mich.

Dr. Hugo Schweitzer, 159 Front st., N. Y.

W. C. Tiffany, 21 Spruce st., N. Y.

The following paper was read: "A Remarkable Water for Public Use," by A. A. Breneman.

The meeting was then adjourned.

DURAND WOODMAN,  
Recording Secretary.

## RECENT THEORIES OF THE SULPHURIC ACID PROCESS.\*

BY WILLIAM R. POTTER.

In preparing the notes which follow, my chief regret has been that I have little or nothing of an original character to communicate to the society upon this occasion. Having devoted the greater portion of my time and energy during the past six years to a few processes of technical chemistry, original work, other than that connected with that branch, has been almost impossible; and the subject which I have the pleasure to bring to your notice this evening is probably, in a general way at least, familiar to all present. For from the time when the student receives his first introduction to test tubes and reagents until his chemical career is ended, sulphuric acid is his almost inseparable companion. As usually explained in the text books on chemistry, one would very readily infer that the chemical phenomena taking place within the lead chamber in the manufacture of sulphuric acid were of the simplest kind; but upon further examination one soon reaches the conclusion that it is undoubtedly more complex. Many eminent chemists have spent years of research upon this process; its literature is enormous; and yet, the lead chamber process remains an unsettled question. In the last few years several chemists of the highest reputation have taken up anew the study of this process, and from two different points: First, the laws governing the reactions by which the manufacture may be brought to a successful working issue; and, secondly, the reactions themselves. It is, of course, almost needless for me to say that manufacturers are most interested in the first, and leave the latter field to those who cultivate pure science.

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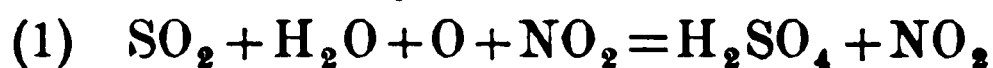
\* Paper read at the regular monthly meeting of the Rhode Island Section of the American Chemical Society, Providence, R. I., February 18, 1892.

As their results either confirm, modify, or disprove the conclusions formerly accepted, I trust that a brief resumé of the researches made and the theories proposed may not be entirely without interest at this time.

As an enumeration and analysis of all the papers bearing upon this subject that have appeared from time to time in the various technical journals would carry us beyond the scope of this paper, I intend this evening to take up only the theories of Hurter, Raschig, Lunge, Sorel, and Schertel.

Dr. F. Hurter, consulting chemist to the United Alkali Co., Limited, of England, has proposed in the *Journal of the Society of Chemical Industry*, vol. 1, pages 8, 49 and 83, a new and novel theory of the chemical reactions of the lead chamber, which he chooses to call "The Dynamic Theory."

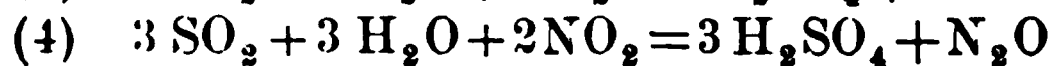
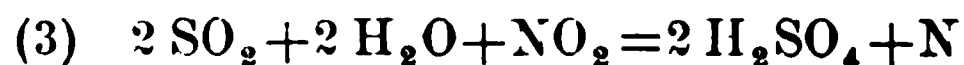
Starting with the premise that the process in the lead chamber is completely stated in one of the following equations :



or



for the normal or primary reactions, *i. e.*, those by which the greater amount of sulphuric acid is produced; and for the secondary reactions, *i. e.*, those which are regarded as explaining the inevitable loss of nitrogen compounds, by either of the following equations :



or



Hurter attempts to show the connection that exists between the dimensions of the chambers and the composition of the gases, the intensity of the reaction and the consequent temperature in the chambers as depending upon the method of combining single chambers into sets, by applying to the equation representing the primary reaction a new principle, which he borrows from the science of chemical dynamics.



The particular principle which Hurter made use of in his investigation was the one referring to the velocity or rate of chemical change, which may be stated as follows :

“ The rate of chemical change depends upon, and is proportional to, the facility with which groups of molecules favorable to the particular change can form in the system in which the change occurs.”

This principle is deduced from, and proved by, the dynamic theory of gases as advanced by Krönig, Clausius, and Clerk Maxwell.

Hurter's paper is largely of a mathematico-chemical nature, and being based on the differential and integral calculus, abounds in mathematical equations and expressions. These I will not weary you with by reproducing them here, but any one interested in the subject will find them stated, and, in general, explained in the papers cited.

The principal practical conclusions which he arrives at from his dynamic study of the process, based upon data derived from practice, are :

1. The work done by a given set of chambers depends principally on the nitrous products in action, and the strength of the acid condensed.

2. In a system composed of several chambers connected together, the energy of the action and the difference between the temperature inside and out of the chamber, decreases from one chamber to another in geometrical progression.

3. The temperature of the first chamber is a function of the relation between the capacity of this chamber and the total volume of the apparatus.

The two theories which are pushed to the front most at present by their respective adherents, are the theories of Raschig and of Lunge. Raschig,\* while conducting an investigation in 1887, on the action of sulphites on nitrites, observed that sulphurous acid

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\* Ann. d. Chem. 241, 242-250.

did not reduce nitrous acid, either in an acid or in an alkaline solution. Condensation products were always formed, which, by their splitting up into simple compounds, made it appear as if a reduction had taken place.

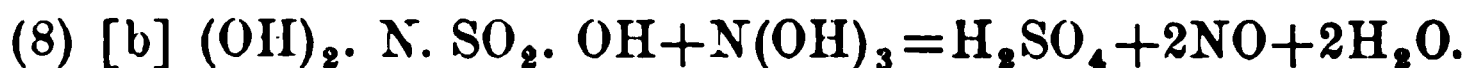
From the data thus obtained Raschig evolved a new theory of the formation of sulphuric acid, which, to say the least, is a novel and ingenious one.

According to this theory, the formation is due to a process of condensation in which dihydroxylaminesulphonic acid plays the principal rôle.

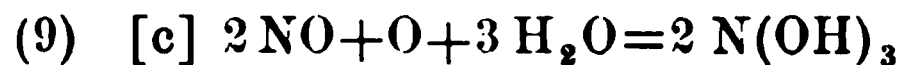
Raschig divides the process into three stages:



That is, one molecule of normal nitrous acid [ $\text{N(OH)}_3$ , or  $\text{H NO}_2 + \text{H}_2\text{O}$ ] combines with one molecule of sulphurous acid [ $\text{SO(OH)}_2$ ] to form dihydroxylaminesulphonic acid.



That is, decomposition of this intermediate product by nitrous acid in excess.

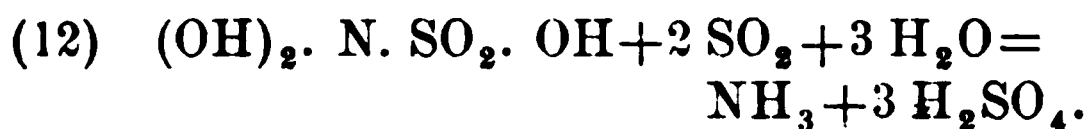
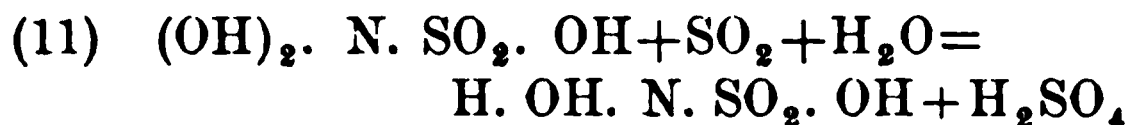


That is, reoxidation of the nitric oxide formed into nitrous acid.

This theory would seem to explain why sulphurous anhydride does not react upon anhydrous nitrogen trioxide.

Finally, the author claims to find in this theory the explanation of the loss of nitrogen compounds which takes place in greater or less amount in the lead chambers. Thus, dihydroxylaminesulphonic acid can be decomposed by sulphuric acid and nitric oxide only when each molecule is in intimate contact, at the moment of decomposition, with one molecule of nitrous acid. If at this moment there is a deficiency of nitrous acid, the intermediate compound is split up into sulphuric acid and nitrous oxide ( $\text{N}_2\text{O}$ ); or, in pres-

ence of sulphurous acid, it will give rise to hydroxylaminesulphonic acid, and finally to ammonia. Thus:

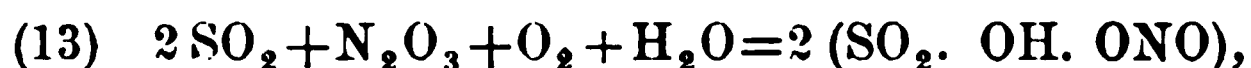


To those who have not closely followed the recent advances made in the sulphuric acid industry, it may be somewhat of a surprise to learn that Raschig actually found in crude chamber acid ammonia varying from 0.0028 to 0.0138 per cent.; and he even goes so far as to say that ammonia is always present in chamber acid, when it is not nitrous. Raschig's statement of the presence of ammonia in chamber acid has recently been confirmed by Mr. R. Hasenclever, manager of the Rhenania Alkali Co., and by Dr. Häussermann, of Griessheim, near Frankfort, Germany.

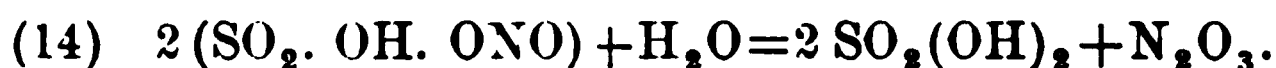
This theory has been strongly opposed by Prof. Geo. Lunge, who claims that it does not take into account the existence of nitrosyl sulphate (the so-called chamber crystals), and that it does not harmonize with the facts of experience. Nitrous oxide, especially, which, according to the theory of Raschig, would be produced abundantly if the dihydroxylaminesulphonic acid did not meet a sufficient excess of nitrous acid, has never been found in any quantity in the gas of the lead chambers. And it is well, too, that such is the case, as otherwise there would be a great loss of nitrogen compounds, nitrous oxide being, as is well known, a very stable compound. Raschig finds, as a strong support of his theory, the fact that ammonia has been found to exist in crude chamber acid, and considers this substance the final product of his reactions; but Lunge thinks it is much more likely that the small quantities of ammonia found are formed more simply by the complete reduction of nitrogen compounds by the sulphur dioxide present. It applies then only to the secondary reactions.

According to Lunge, who has probably, in recent years, given more time to and thrown more light on this subject than any other

investigator, nitrosyl sulphate, or nitroso-sulphonic acid, technically known as chamber crystals, plays the principal part in the chemical mechanism of the formation of acid in the chambers. This compound, produced by the combination of sulphurous anhydride, water vapor, nitrogen trioxide, and oxygen, according to the following equation:



hovers as a mist in the atmosphere of the chamber and is immediately decomposed in the presence of an excess of steam, into sulphuric acid, which falls to the bottom of the chamber, and nitrogen trioxide which is free to act upon a second molecule of sulphur dioxide, as follows:



Nevertheless, in the front end of the first chamber, in presence of an excess of sulphurous vapors, the nitrosyl sulphate is denitrified, and the nitric oxide formed unites with the sulphur dioxide, steam, and oxygen, to again form the chamber crystals:



The same compound can also be produced by the reaction of sulphurous anhydride upon nitric acid.



As to the direct conversion of sulphurous acid into sulphuric acid by the reduction of nitrogen tetroxide, or of nitrogen trioxide, according to the old theories, it is certain that it takes place only to a very insignificant amount.

Lunge and Naef, in a paper in the *German Chemical Industry* for 1884, based upon a series of experiments carried out jointly by them, state that the composition of the nitrous gases in a chamber working under normal conditions is incompatible with the presence of nitrogen tetroxide. Up to within a short time, it was quite generally held that nitric oxide itself was produced only at the end of the process, by a secondary reaction; but recently nitric

oxide has been found in the thick white fumes of the first working chamber behind the Glover tower, and has been explained in two ways : (a.) Sulphur dioxide, nitrogen compounds, oxygen, and water vapor meet here in the highest state of concentration, and here the highest temperature prevails ; it is also here that the reactions proceed most actively, and the formation of sulphuric acid is most abundant. Under such conditions, it is not unlikely that a portion of the sulphur dioxide is directly oxidized to sulphuric acid, according to the equation:



or,

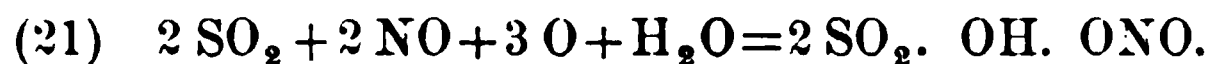


(b.) The nitrososulphonic acid already formed may here, owing to the excess of sulphur dioxide, steam, and the relatively high temperature prevailing, be denitrated, as follows:



This reaction is the same as that taking place in the Glover tower immediately before, where the nitrous vitriol from the Gay Lussac tower, which is simply sulphuric acid holding in solution nitrososulphonic acid, is subjected to the same conditions.

Thus is the presence of nitric oxide in this part of the apparatus accounted for; and the nitric oxide so formed is undoubtedly afterwards oxidized, not simply by the oxygen of the air, to form nitrogen tetroxide, as in the old theories of Berzelius, Davy, Weber and others, which reaction has since been found to take place only in the presence of dry oxygen, which is quite different from the oxygen existing in the steam laden atmosphere of the lead chambers, but by oxygen in the presence of sulphur dioxide and steam to form nitrososulphonic acid; thus:



It may be well, perhaps, to mention here that the gases of the second chamber have been found to contain only nitrogen trioxide, and not nitric oxide, showing that the formation of nitric oxide observed in the gases of the first chamber was merely local.

Lunge tersely sums up the results of his labors on this subject, which have appeared in full in the *Berichte* from time to time during the past five or six years, in these words:

“The formation of sulphuric acid is determined, not by a succession of reductions and oxidations of nitrous gases, but by a condensation of nitrogen trioxide (or nitric oxide) with sulphurous acid and oxygen to nitrosyl sulphate, which is decomposed into sulphuric acid, with regeneration of nitrous acid (nitrogen trioxide)”.

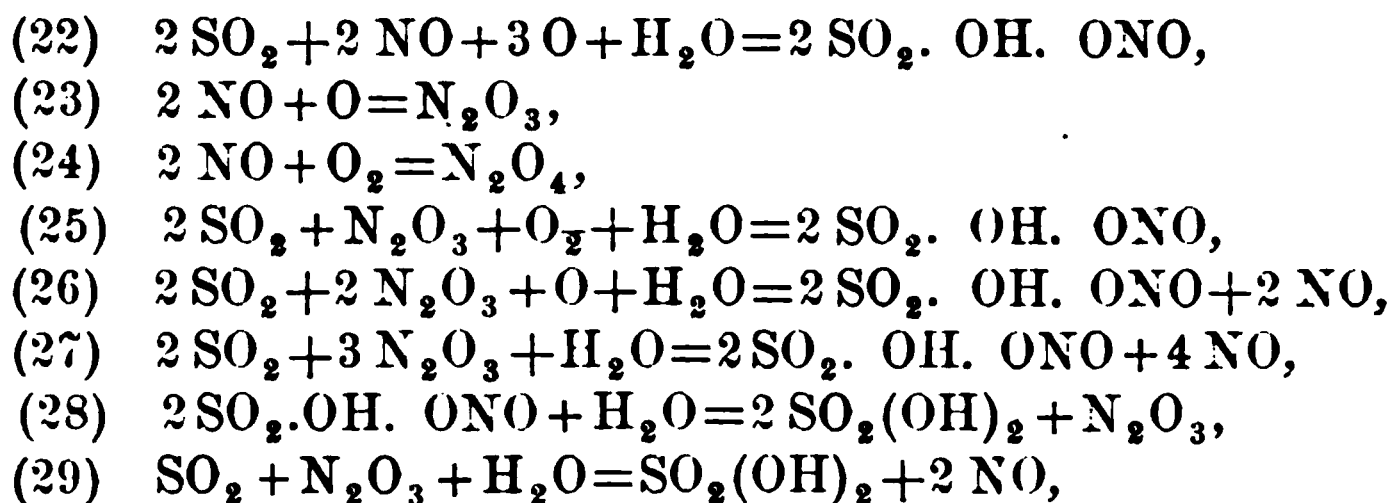
Theoretically, a small amount of certain nitrogen compounds, in the presence of an excess of oxygen, should be sufficient to oxidize an infinite amount of sulphurous acid to sulphuric acid. That this is not the case practically, acid manufacturers know only too well. This is the “bone of contention” of the technical chemist, at which many have gnawed; but only to find that their efforts have in a great measure been in vain. The cause of this variance between theory and practice may be attributed to two sources, namely, the mechanical loss of nitre and the chemical loss. The former is a very variable quantity, depending upon the construction, distribution and arrangement of the apparatus, is not the same in any two works, and need not concern us at this time. The chemical loss, which, in well constructed and properly managed works makes up about seventy-five per cent. of the total loss, must most assuredly be taken into account by any one promulgating a new theory of the chamber process. Lunge recognizes this fact, and in his theory accounts for the loss in somewhat the following way. In normal working nitrogen trioxide is found only in the gaseous mixture at the exit from the last chamber. Under certain conditions the formation of nitrous oxide can take place by the action of sulphur dioxide upon nitrogen trioxide: but this reduction can occur only in presence of an excess of steam, or when the sulphuric acid in the chamber is weaker than it ought to be in normal working. The excess of steam in a chamber being usually only local, and generally only temporary, the reduction from this cause must occur very rarely. The formation of nitrogen tetroxide in the gas at the end of the system constitutes a much more important source of loss. It is formed by

a condensation of nitric anhydride in the pan acid of the last chamber, but not in the nitrous acid of the condenser, for the coke packing, and, perhaps, also the traces of sulphurous acid which have escaped oxidation, reduce the nitrogen pentoxide. Lunge makes the paradoxical statement that the production of nitrogen tetroxide is entirely independent of the amount of oxygen present in the gaseous mixture at the time, and that it takes place equally as well in presence of a deficiency as of an excess of oxygen. It is caused solely by a very large excess of nitrous products in the gases. In this case, the oxidation of the sulphurous acid is completed long before it gets to the last chamber, so that condensation of sulphuric acid is altogether wanting here. The nitrogen trioxide no longer encountering gaseous molecules with which to combine to form nitrososulphonic acid, is itself oxidized finally to the state of tetroxide in presence of a large excess of oxygen. A portion of this then combines with the chamber acid to form nitrosyl sulphate and nitric anhydride; another portion escapes with the gases into the Gay Lussac absorbing tower, where it is incompletely condensed, owing to the latter's inability to do the extra work thus put upon it, and ultimately escapes into the atmosphere, thus becoming lost to the process.

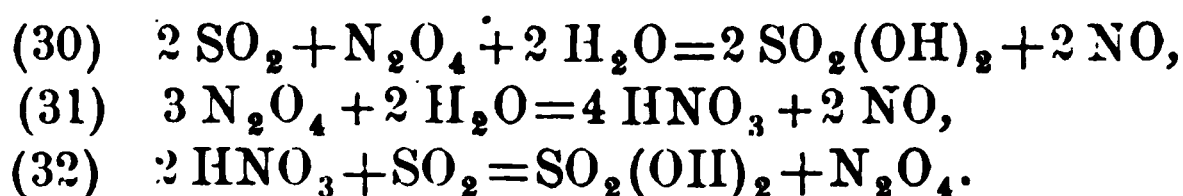
E. Sorel, in a paper published in the *Bulletin de la Societe Industrielle de Mulhouse* for April and May, 1889, formulates a theory a little different from that of Lunge's.

While giving to nitrososulphonic acid an important part in the formation of sulphuric acid, he regards the chemical reactions as a series of successive oxidations and reductions of the nitrogen compounds, caused by variations of concentration and of temperature of the sulphuric acid condensed. In presence of concentrated acid, nitric oxide and sulphurous acid give rise to nitrosyl sulphate. On dilution of the sulphuric acid this intermediate product is decomposed into sulphuric acid and nitrogen trioxide, which oxidizes directly the sulphurous acid. The principal and

secondary reactions which take place according to Sorel's theory, may be represented by the following equations:



to which may be added the following reactions, which take place under certain conditions:



From experiments recently performed by A. Schertel (*Chemische Industrie*, 1889, p. 80), on the manufacture of sulphuric acid, the observations upon which Lunge's theory rests have been confirmed in every particular.

Schertel showed experimentally the presence of nitrosyl sulphate in the atmosphere of a lead chamber working normally. The gases at the exit of the first chamber of a series were led through a lead pipe filled with coke, which, after having been carried down below the second chamber, made a turn into the leaden wall of the head of the second chamber. After allowing the gases to pass through this pipe for several weeks, nitrosyl sulphate (chamber crystals) was found upon opening the pipe. The crystals were distinctly formed, and were deposited upon the coke in the direction of the current of the gases, although the strength of the acid condensed in the pipe was kept much below that usually maintained in chambers.

I have now laid before you the source and extent of the latest information concerning the sulphuric acid process. From our present knowledge of the chemical reactions of the lead chamber, it would seem that of the many theories proposed, Lunge's har-



monizes most closely with experience. And though exceptions may, and have, been taken to some of his conclusions, and although the existence of nitrogen trioxide in the gaseous state is not proven beyond a doubt, yet, I think I may say, without fear of contradiction, that Dr. Lunge has given us the clearest and most trustworthy explanation of the formation of sulphuric acid that has yet appeared, and one that is not likely to be soon displaced.

A REMARKABLE WATER FOR PUBLIC USE.

By A. A. BRENEMAN.

I have had occasion recently to examine a sample of water taken from the public supply of Long Island City. The water has been a source of much complaint. It is taken from driven wells at a point near Bowery Bay, on Long Island Sound, a few miles from New York City. The wells are said to be rather shallow.

The composition of the water was found to be as follows, in grains per U. S. gallon :

Total solids,	73.665
Sodium chloride,	35.242
Calcium bicarbonate,	6.840
Magnesium bicarbonate,	10.536
Calcium sulphate,	6.283
Magnesium sulphate,	1.437
Magnesium chloride,	7.584
Ferric oxide and alumina,	4.286
Organic and volatile water,	4.505
Insoluble sediment, silica, etc.,	3.892
	80.595
Less Water and CO <sub>2</sub> of bicarbonates,	6.930
	73.665

The water is probably a mixture of well water and sea water. The abundance of magnesium chloride, a characteristic ingredient of sea water, as well as the large excess of common salt, point to this conclusion.

It is said that low ground near the wells is occasionally overflowed with sea water at times of storm or high tide on the Sound and the wells may be contaminated in this way. It is possible also that there is direct percolation of sea water through the soil from the Sound, which is only a short distance from the wells. This water is entirely unsuited for public supply. Its taste is perceptibly saline, especially if taken immediately after drinking pure water. It yields a heavy scale in boilers and has caused much trouble where it was used for manufacturing purposes.\*

The sample for the above analysis was taken from a hydrant in Long Island City, Nov. 28, 1891. Samples taken from hydrants in different parts of Long Island City at later dates, for comparison, showed the following results in total solids :

January 12, 1892, . . . . . 66.184

February 5, 1892, . . . . . 46.490

The water evidently varies greatly in composition, a fact which comports also with the theory of admixture of land and sea water under complex and varying physical conditions.

An analysis of a sample of well water from Long Island City was made for comparison with the above. The composition was as follows :

Total solids,	. . . . .	45.720
Sodium chloride,	. . . . .	16.143
Sodium sulphate,	. . . . .	5.328
Calcium bicarbonate,	. . . . .	10.232
Magnesium bicarbonate,	. . . . .	8.616
Calcium sulphate,	. . . . .	.168
Magnesium sulphate,	. . . . .	1.020
Ferric oxide and alumina,	. . . . .	1.474*
Organic and volatile,	. . . . .	7.089
Insoluble sediment, silica, etc.,	. . . . .	3.209
		<u>53.279</u>
Less Water and CO <sub>2</sub> of bicarbonates,	. . . . .	7.559
		<u>45.720</u>

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\* Since the above was written complaint has been made by florists in Long Island City, that the city water is injurious to the leaves of plants that are watered with it.

From this analysis it would appear that the underground water of the district is little better than that supplied by the water works. It is free, however, from magnesium chloride, which is quite an important constituent of the hydrant water.

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## Abstracts of American Patents Relating to Chemistry.

*(From the U. S. Patent Office Gazette.)*

*February 2, 1892.*

**467,916.**—Apparatus for making carbonated beverages. Henry Carse, Rock Island, Ill.

**467,981.**—Brick kiln. George C. Little, Vance, Kan.

**467,987.**—Apparatus for purifying or sorting grits. Carl Haggemacher, Buda-Perth, Austria-Hungary.

**467,992.**—Process of decolorizing vegetable oils. Walter N. Hartley, Dublin, Ireland, and William E. B. Blenkinsop, London, Eng.

The oils to be decolorized are mixed with a suitable proportion of a manganese soap and a current of air or oxygen blown into the mixture.

**467,993.**—Apparatus for the production of yeast or similar substances. Alfred Jörgensen, Copenhagen, Denmark, and Axel Bergh, Stockholm, Sweden.

**468,049.**—Azo dye. Christian Rudolph, Offenbach, Germany.

A blackish powder with metallic lustre, having the properties of dyeing unmordanted cotton directly blackish violet. Soluble in water with violet blue color, and in conc. sulphuric acid with blue color. Reducing agents decolorize the solutions. The dyestuff is obtained by treating tetrazodiphenyl or ditolyl with one molecule of amidooxyalphanaphthalinedisulpho acid and with one molecule of metaoxydiphenylamine or metaoxytolylphenylamine.

**468,050.**—Beer cooler. Valentin C. Trabold, Newark, N. J.

**468,063.**—Amalgamating silver ores. Alexis Janin, San Francisco, Cal.

The ore is subjected to the action of free hypochlorous acid, formed by the action of carbonic acid gas or an acid salt on a solution of chloride of lime, agitating the mixture of ore and solution until the silver minerals are chloridized and the free hypochlorous acid or chlorine present have formed combinations having little or no injurious action on mercury, then adding mercury, and concluding the amalgamation in the usual manner.

**468,066.**—Separator. Fairfax H. Wheelan, Santa Barbara, Cal.

**468,084.**—Feed water purifier. Frederick J. Henderson, Chicago, Ill.

**468,138.**—Apparatus for separating oil and water from gas. Charles L. Stock, Fostoria, Ohio.

**468,142.**—Blue azo dye. Moritz Ulrich, Elberfeld, Germany.

A coloring matter derived from the diazo derivative of the paramido-benzol-sulphonic acid with dihydrooxynaphthalinemonosulpho acid of Letters Patent No. 444,679. The aqueous solution is bluish red, also the solutions with sodium carbonate and ammonia. Conc. sulphuric acid dissolves the dye with deep violet blue color.

**468,148.**—Process of separating aluminium. Charles S. Bradley, New York, N. Y.

“A process for separating or dissociating aluminium from its ores or compounds, consisting in fusing and maintaining the fusion and electrolytically decomposing the compound by the passage of the electric current through it, and regulating the strength of said current in accordance with the requirements of the fused mass.”

**468,216.**—Apparatus for manufacturing oxides of metals. William H. Birge, Franklin, Pa.

Composition of matter and process of preparing comminuted iron ore. Gordon Conkling, Glen Falls, N. Y.

Comminuted iron ore is mixed with magnesium chloride and magnesium oxide and then pressed into bricks or lumps of convenient size and allowed to harden.

**468,232.**—Combined feed water heater, oil extractor, and water purifier. Ferdinand Buer, St. Louis, Mo.

**468,249.**—Machine for decorticating fibrous plants. Charles Lanaux and Manuel E. Rendon, Merida, Mexico.

**468,290.**—Concrete mixing machine. William C. Barr, Jersey City, N. J.

**468,292.**—Method of casting iron pigs, ingots, etc. James W. Cole, St. Louis, Mo.

**468,294.**—Filter. James H. Drake, St. Paul, Minn.

**468,306.**—Cupola furnace. Carl Sahler, Cologne-on-the-Rhine, Germany.

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*February 3, 1892.*

**468,320.**—Manufacture of vitreous bricks. James C. Anderson, Highland Park, Ill.

Sodium chloride or kindred salt or alkalies and the clay are mixed while dry, reduced to an impalpable powder, and then pressed into brick or other form and then exposed to heat.

**468,321.**—Art of coloring brick. James C. Anderson, Highland Park, Ill.

Coloring matter is applied to the partially burned brick and then subjected to a final burning.

**468,326.**—Apparatus for ageing and rectifying alcoholic liquids by ozone. François Broyer and Paul Petit, Tournus, France.

**468,345.**—Grease Extractor. Levi Hussey and Edward McCann, New York, N. Y.

**468,374.**—Apparatus for charging gas retorts. George C. Trenby, London, England.

**468,378.**—Apparatus for separating smoke from gases of combustion. William Wills, Longstreth, Ohio.

**468,404.**—Composition for bricks. William Wade, Louisville, Omaha, Nebraska.

**468,406.**—Ore Washer. Ernest E. Crepin, Chicago, Ill.

**468,408.**—Smoke bleacher. Daniel S. and Peter J. June, Fremont, Ohio.

**468,498.**—Purifying cocoanut oil. George H. Weiss, Jersey City, N. J.

The oil is treated with steam, then with a mixture of alcohol and sulphuric acid, then again subjected to the action of steam, and finally washed with alcohol.

**468,510.**—Apparatus for the manufacture of lampblack. Godfrey L. Cabot, Cambridge, Mass.

**468,533.**—Metallurgical plant. Edward L. Ford, Youngstown, Ohio.

**468,539.**—Red dye. Otto Borgmann, Berlin, Germany.

The process consists in combining a "diazo compound of tolidine with beta-naphthylamine disulpho acid R, adding to the resulting intermediate body naphthionate of soda, allowing the mixture to stand until the reaction is complete, neutralizing with an alkali, and salting out the dye stuff." A red dye stuff, readily soluble in hot water, insol. in alcohol, precipitable from aqueous solutions by alkalies, sol. in conc. sulphuric acid with greenish-blue color, and decomposed by reducing agents into tolidine and diamidonaphthalinemono and disulpho acids.

**468,540.**—Ore separator. Henry Cane. Spokane Falls, Wash.

**468,544.**—Crushing mill. Frank A. Huntington, San Francisco, Cal.

**468,546.**—Process of extracting iron or steel or other metals from ores. Nicolas Lébedeff, St. Petersburg, Russia.

The ore or metaliferous material is melted on a bed of limestone or dolomite, and at the time the mass melts carbon is introduced into the molten mass.

**468,558.**—Apparatus for carbonizing the vegetable matter in wool. Benni Bellerstein, Neuss, Germany.

**468,579.**—Machine for dyeing fabrics. William M. Robertson, Newark, N. J.

**468,591.**—Process of ornamenting vases or similar articles. John Baynes, Westchester, N. Y.

**468,599.**—Magnetic separator. Erminio Ferraris, Turin, Italy.

**468,610.**—Mold for casting acid-eggs. Edward Allen, Baltimore, Md.

**468,617.**—Regenerative furnace. William Hill, Collinsville, Conn.

**468,627.**—Manufacture of India rubber. Adolphus I. Rath, Hyde, Eng.

**468,631.**—Ice cream or water ice. William H. Allen, Detroit, Mich.

An edible ice "containing a composition of citric acid and bicarbonate of soda."

**468,645.**—System and apparatus for heating, cooling and ventilating buildings. William M. Decker, Kingston, N. Y.

**468,651.**—Brick or tile machine. Egbert M. Freese, Plymouth, Ohio.

**468,664.**—Filter. Edward M. Knight, San Francisco, Cal.

**468,670.**—Feed water filter and separator. Elwood O. Mandigo, Brooklyn, N. Y.

**468,688** }  
**468,689** } Process for treating finely divided or powdered substances of different specific gravity. Orbin B. Peck, Chicago, Ill.

**468,706.**—Magnetic extractor. Horatio W. Southworth, New York, N. Y.

**468,723.**—Producing opalescent glass. Joseph Kempner, Goerlitz, Ger.

“ A glass batch consisting of 25 units of sodium silicofluoride, 46 of sodium carbonate, 12 units of chalk, 165 units of sand, or substantially these proportions.”

**468,731.**—Fruit evaporator. Charles W. Soverhill, Newark, N. J.

**468,736.**—Furnace for wasting ores. Charles M. Allen, Butte City, Mont.

**468,740.**—Annealing process. Samuel H. Brown, Boston, Mass.

**468,747.**—Process of and apparatus for the manufacture of illuminating gas. Charles B. de Lamarre, Beloxi, Miss.

**468,751.**—Process of making food compounds. Robert McKinney, Detroit, Mich.

Vegetables, sliced or grated, are first saturated in water containing sodium chloride and boracic acid, then bleached, dried, and thoroughly dessicated.

*February 16, 1892.*

**468,777.**—Method of copying written or printed documents executed in carbonaceous inks. George H. Ball, Watervliet, N. Y.

**468,808.**—Method of brewing. Charles F. Lawton, Rochester, N. Y.

**468,809.**—Method of and apparatus for the manufacture of beer. Charles F. Lawton, Rochester, N. Y.

**468,834.**—Regenerative gas furnace and producer. Frederick Siemens, Dresden, Germany.

**468,835.**—Method of working regenerative gas furnaces and gas producers. Frederick Siemens, Dresden, Germany.

**468,851.** } —Furnaces for burning garbage. George H. Warner, Hart-

**468,852.** } ford, Conn.

**468,858.**—Centrifugal filtering apparatus. David Williamson, New York, N. Y.

**468,866.**—Compound for removing grease and stains. George S. Cox, Cooksville, Tex., and Georgia M. Lewis, Rosalie, Tex.

**468,867.**—Manufacturing asphaltum. Jesse A. Dubbs, Allegheny, Pa.

The method consists in “subjecting crude petroleum or residuum thereof and sulphur to a suitable heat, reducing such heat, charging in an

additional amount of sulphur, again subjecting the entire charge to a further heat, adding more sulphur, and continuing the heat until the product has attained the desired degree of hardness."

**468,880.**—Electrolytic cell. Ernest A. Le Suem, Ottawa, Canada.

**468,887.**—Electrolyte or depolarizing solution for galvanic batteries. Samuel Miller, London, England.

The solution contains sodium nitrate, potassium bichromate, sodium chloride, and a suitable acid.

**468,891.**—Apparatus for concentrating sulphuric acid. Charles Négair, Perigneux, France.

**468,913.**—Distilling apparatus. Nelson Hunting, Albany, N. Y.

**468,931.**—Ore concentrator. Hannibal Scovell, Portland, Col.

**468,937.**—Viscid fatty compound. Adolph Summer, Berkeley, Cal.

The improvement in preparing the compound consists in cooling the oil to a temperature of about or below 15° C previous to the addition of the chloride of sulphur.

**468,956.**—Process of producing inflammable gases. Alonzo Noteman, Toledo, Ohio.

**468,984.**—Filter. Ernest Boeing, Bod Nanheim, Germany.

**469,037.**—Apparatus for treating ores. Oscar Bilharz, Freiberg, Germany.

**469,053.**—Manufacture of glassware. George Beatty, Tiffin, Ohio.

**469,058.**—Device for cooling and graining maple sugar. John W. Currier, North Troy, Vt.

**469,065.**—Ore pulverizer. Jacob A. Pearse, Denver, Col.

**469,086.**—Composition of matter for fire kindling. Henry W. Kling, Syracuse, N. Y.

A composition consisting of sawdust, resin, charcoal, pitch, vegetable oil and tallow.

**469,104.**—Zinc furnace. Herman G. Tessmer, Pittsburg, Kan.

**469,108.**—Hydrocarbon burner. Lewis B. White and John V. Reit-mayer, New York, N. Y.

**469,111.**—Process of making plastic compositions. Joseph H. Amies, Scranton, Pa.

**469,120.**—Ore crusher. Joseph Brumbaugh, Gold Hill, Ore.

**469,142.**—Composition of matter. Philip H. Holmes, Gardiner, Me.

A composition of matter consisting of plumbago, finely divided fibre and cotton seed oil molded under pressure into desired forms and solidified and hardened by heat.

**469,151.**—Brick kiln. Charles Klose, Dornphan, Neb.

**469,202.**—Ore concentrator. Gustavis L. Cudner, New York, N. Y.

**469,207.**—Air cooling and purifying apparatus. Israel L. Good, Allentown, Pa.

**469,212.**—Smoke consumer. John N. Merrill, Burlington, Iowa.

*February 23, 1892.*

**469,222.**—Fiber cleaning machine. José G. Bodin, New York, N. Y.

**469,225.**—Brick machine. Michael Bierline, Chaska, Minn.

**469,238.**—Apparatus for making cylindrical rods of parchementized fiber. Robert P. Frist, Wilmington, Del.

**469,240.**—Process of manufacturing floor cloth or like fabrics. Henry W. Godfrey, Charles F. Leake and Charles E. Lucas, Staines, Eng.

**469,244.**—Blue-printing apparatus. Paul Heinze, Chicago, Ill.

**469,261.**—Smoke consumer and fuel saver. Gordon McDowell, Evanston, Ill.

**469,269.**—Process of smelting and raising fumes from complex ores.

**469,285.** Insecticide. William D. Sunderlin, Green Island, N. Y.

A dried and pulverized precipitate obtained from the liquor employed in making caustic soda solutions and known as "lime mud."

**469,305.**—Lard cooling tank. Benjamin Rosenthal and Orville D. Noble, Chicago, Ill.

**469,329.**—Blue dye. Arthur Weinberg, Mainken, Germany.

A thionine derivative of paratoluylenediamine, a dark green crystalline powder easily sol. in water and in spirits. Sol. in alcohol with blue color which is turned red by caustic soda. Sulphuric acid dissolves the dye with a pure green shade.

**469,399.**—Brick machine and mold sander. John Farnen and John Mulloy, Chicago, Ill.

**469,406.**—Glass furnace. William F. Modes, Streator, Ill.

**469,439.**—Apparatus for the final concentration of oil of vitriol. Russell S. Penniman, Dover, N. J.

**469,443.**—Vapor burner. John E. Donovan, Cincinnati, Ohio.

**469,450.**—Filter. Virgil H. McConnell, Buffalo, N. Y.

**469,454.**—Process of and apparatus for controlling the discharge of molten contents of crucibles or other vessels. Augustus J. Rogers, Milwaukee, Wis.

**469,477.**—Refrigerating apparatus. Charles W. Isbell, New York, N. Y.

**469,495.**—Rotary disintegrator and separator for fibrous materials. Berthold Ziegler, Todtnau, Germany.

**469,498.**—Apparatus for refining oils. Christian Dorn, Philadelphia, Pa.

**469,538.**—Process of an apparatus for electroplating the hulls of vessels. Alexander D. Buchanan, Long Island City, N. Y.

**469,566.**—Amalgamator. James W. Hawthornthwaite, San Francisco, Cal.

**469,574.**—Apparatus for the manufacture of Gas. James R. Kendall, Terre Haute, Ind.

**469,599.**—Method of and apparatus for separating slime or fines from water used in milling oils. Albion M. Rouse, Boulder, Col.

**469,634.**—Paint. William B. Grover, Philadelphia, Pa.

Bituminous gas coal tar is used as the basis and mixed with various acids resisting minerals.

J. F. G.





REGULAR MEETING, MARCH 4, 1892.

The regular meeting of the Society was called to order at 8:45 P. M. in the Law Lecture Room of the University. Prof. A. C. Hale in the chair.

The minutes of the February meeting were read and accepted, Prof. Hale, Corresponding Secretary, made an informal report on the progress of the Rhode Island Section, from responses to his written inquiry. Prof. Breneman here took the chair.

The following gentlemen were elected to membership :

Theo. Breyer, 159 Front street, N. Y.

Thos. Lynton Briggs, 357 Madison street, Brooklyn, N. Y.

Prof. Edward D. Campbell, Ann Arbor, Mich.

Prof. Delos Fall, Ann Arbor, Mich.

Mr. A. G. C. Hahn, 64 Perry street, N. Y.

Geo. O. Higby, Ann Arbor, Mich.

Lyman F. Kebler, Ann Arbor, Mich.

Jesse Jones, 94 Buena Vista street, Allegheny, Pa.

Prof. W. B. Lindsay, Carlisle, Pa.

C. E. Lineburger, North Div. High School, Chicago, Ill.

Prof. Frederick G. Novy, Ann Arbor, Mich.

Dr. Hugo Schweitzer, 159 Front street, N. Y.

W. C. Tiffany, 21 Spruce street, N. Y.

The following nominations were made :

Othmar Eberbach, Ann Arbor, Mich.

Wm. F. Edwards, B. S., Ann Arbor, Mich.

Prof. Howard V. Frost, Pol. Inst., Brooklyn, N. Y.

C. McLaughlin, 874 Broadway, N. Y.

David M. Lichty, Ann Arbor, Mich.

Prof. W. R. Orndorff, Cornell Univ., Ithaca, N. Y.

John F. Rogers, 167 Prospect street, Providence, R. I.

Julius O. Schlotterbeck, B. S., Ann Arbor, Mich.

The chair called attention to the fact that suggestions were

asked for from all members in regard to the proposed revision of the constitution.

The following papers were then read :

I. "On the Alcohols of Fusel Oil," by Dr. R. C. Schüpphaus ; read by the secretary, in the absence of the author.

II. "On a Peculiar Organic Growth in Water," by Jas. H. Stebbins, Jr.

III. "On Glass as Used in Manufacturing of Incandescent Electric Lamps," by Durand Woodman, Ph. D.

After some discussion the meeting was adjourned.

DURAND WOODMAN,  
Recording Secretary.

## ON THE ALCOHOLS OF FUSEL OIL.

BY ROBERT C. SCHÜPPHAUS.

About a decade ago fusel oil or commercial amylic alcohol could be procured for little more than the cost of cartage. In those days it was chiefly used in the manufacture of alkaloids, especially quinine. The quantities consumed in the preparation of valeric acid and its salts and various amylic ethers were unimportant. The conditions abroad were about the same. Though fusel oil was repeatedly proposed as a substitute for alcohol in the manufacture of spirit varnishes, its application did not meet with favor, both on account of its odor and its comparative lack of volatility. In the production of coal tar dyes it has been but rarely employed.

Cyanine or quinoline blue is obtained by treating quinoline with amyl iodide and subsequently treating with an alkali. Amyldiphenylamine furnishes, on heating with oxalic acid, a bluish green dye. The iodide and chloride of amyl required in these processes were prepared from fusel oil. In the manufacture of methyl green from methyl violet our method of purifying the dye stuff consisted in dissolving the crude product in water and agitating the solution with amyl alcohol, which dissolves the green, leaving the violet in the aqueous solution. All these processes are obsolete.

H. Briem\* recommended the fusel oil from the fermentation of beet-sugar molasses as a crude material for the production of illuminating gas of superior quality, and in 1880 he† reported that several factories had introduced the process, among others a distillery. The latter concern enjoyed, of course, special facilities, putting a value of only eight cents a gallon on the material R. v.

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\* Organ des Central-Vereins für Rübenzucker-Industrie in der Oest. Ung. Monarchie, 1877, p. 180, 1879, p. 265.

† Ib., 1880, p. 20.

Wagner\* comments on Briem's proposition as follows: "It seems to me as if fusel oil could be utilized for something better than making gas. If there is no better outlet, let it rather go to waste, and wait for better times." And better times did come. In 1882 John H. Stevens† introduced fusel oil as a substitute of grain alcohol in the manufacture of celluloid. The mixture of alcohols constituting fusel oil forms, in conjunction with camphor, an efficient solvent of nitrocellulose, especially at elevated temperatures. In this connection it is worthy of note, that Arthur H. Elliott,‡ in his interesting paper on nitro-saccharose, mentions amyl alcohol as a solvent of this substance. From the very discovery of pyroxyline more or less successful attempts had been made to employ it as a base for varnishes. But the pyroxyline varnish industry did not begin to flourish until amyl acetate was utilized as a solvent, which was in 1879. John H. Stevens|| patented its use in the manufacture of celluloid in 1882. Otto P. Amend§ introduced, in 1887, for similar purposes, the products of chlorination of amyl alcohol and acetate. In 1884 I found that pure amyl alcohol is far less useful in the manufacture of celluloid than the commercial article, which observation led me to the discovery that propyl and isobutyl alcohols are to be preferred to the higher homologue.\*\* Mixtures of propyl and butyl alcohols can be procured at very moderate prices in European markets. At the same time I proposed propyl and butyl acetates for the manufacture of pyroxyline varnishes. Walter D. Field†† obtained a patent for such varnishes in 1887. Large quantities of the acetates of propyl, butyl and

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\* Wagner's Jahresb., 1879, p. 1216.

† U. S. Patent 269,343, December 19th, 1882, filed June 12th, 1882.

‡ This Journal, 4 (1882), 147.

| U. S. Patent 269,340, Dec. 19th, 1882, filed June 12th, 1882.

§ U. S. Patent 371,021, October 4th, 1887, filed May 11th, 1887. U. S. Patent 372,100, Oct. 25th, 1887, filed May 4th, 1887. U. S. Reissue 10,879, Nov. 8th, 1887, filed Oct. 15th, 1887.

\*\* U. S. Patent 410,204, Sept. 3d, 1884, filed Oct. 19th, 1886.

†† U. S. Patent 381,354, April 17th, 1888, filed August 13th, 1887.

amyl are consumed in the manufacture of photographic films. Amyl acetate has also been used in the preparation of some of the smokeless powders, the Wettern, for instance.

The burning fluid in Hefner's standard lamp for photometric purposes is amyl acetate. The acetate, butyrate and valerate of amyl enter into the composition of the artificial fruit essences and flavors. A few years since they found an ephemeral application in perfumery, when fashion, in one of her capricious moods, decreed that the delicate scents of flowers must yield to the more substantial odors of fruits.

E. Liebert\* adds amyl nitrate to nitroglycerine to diminish its sensitiveness to cold and concussion. A variation of his process consists in mixing glycerine either with amyl nitrate or amyl alcohol before subjecting it to the action of the nitrating mixture. Amyl nitrate is employed in medicine; in the chemical laboratory it serves in the preparation of diazo and kindred compounds.

The analyst makes use of pure amyl alcohol in the separation of alkaloids. Isobutyl alcohol or its chloride is employed in the manufacture of the artificial musks, trinitro derivatives of butyltoluol and butylxylol. Valeric acid is obtained through the oxidation of amyl alcohol. Le Bel† described a method of preparing inactive amyl alcohol from the fermentation product, and showed that valeric acid from this source is identical with the officinal *acidum valerianicum e radice parata*, a fact all the more important as the valerates made from active alcohol will not crystallize. Hydrated valeric acid, and the valerates of ammonium, sodium, iron, zinc, bismuth and quinine are well known remedies.

Pental (one of the amylenes), an anæsthetic, and hydrate of amylene, a hypnotic, are both derived from amyl alcohol. Prior to 1858, amylene was employed in dentistry, but owing to imperfect methods of manufacture, fell into disrepute. Fusel oil yields, on heating with zinc chloride crude amylene, which, through treatment with sulphuric acid and subsequent decomposition with water is converted into amylene hydrate or tertiary amyl alcohol.

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\* D. R. P. 51022, of March 29th, 1889.

† Compt. Rend. 86 (1878), 213.

This alcohol, when heated with dilute sulphuric acid, furnishes pure amylene or "pental," i. e., trimethyl ethylene, B. P. 38° C.

This enormous increase in the consumption of fusel oil, or its separate constituents, has brought it about not only that the domestic article finds a ready market, but that large quantities are imported from abroad. But whilst the consumption is steadily on the increase, the production does not keep step with it. One gallon to each three hundred of crude spirit may be said to be the average yield, and from this a large quantity of ethyl alcohol may be extracted by cautious distillation. Moreover, every progressive distiller bends his whole energy to counteracting its formation, and Linnet's\* researches, and Springer's† method of producing alcohol point to success in this direction. It must be borne in mind, however, that with free alcohol for the arts and manufactures the use of fusel oil would be abandoned in several branches.

Fusel oil was discovered by Scheele‡ in the tailings from the rectification of rye whiskey. Pelletan§ obtained and examined a similar product from potato spirit. In the revised edition of Watts' Dictionary of Chemistry fusel oil is defined as a volatile liquid present in the product of the alcoholic fermentation of the saccharine liquids derived from potatoes, wheat, etc., and of the juice of grapes, beets, etc. It passes over in the latter portion of the distillate when these liquids are rectified. Fusel oil always contains amyl and ethyl alcohols, usually isobutyl and n. propyl alcohols, some fatty acids and some ethers. The three higher alcohols mentioned became first known to science through the examination of fusel oils.

Dumas§ isolated amyl alcohol, B. P. 131.5°, from potato fusel oil and ascertained its percentage composition, without recognizing, however, its alcoholic nature. Cahours\*\* investigated the

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\*Compt. Rend. 112 (1891), 663.

†Scientific American Supplement of Sept. 26th, 1891, p. 13125.

‡Crell's Ann., 1785, I. 61.

§Ann. Chim. phys. [1] 30 (1825), 221.

§Ann. Chim. phys. [1] 56 (1834), 314.

\*\*Compt. Rend. 4(1837, 341, and Am. Chim. phys. [1] 70 (1839) 81, and [1] 75 (1840). 193.

same product and showed that it was a substance analogous to common alcohol and belonging to the same natural series of which methyl and ethyl alcohols form the first two members. Balard\* obtained it from the fusel oil formed in the fermentation of grape skins, and prepared quite a series of amyl compounds. In a fusel oil of the same origin Chancel† discovered n. propyl alcohol. Wurtz‡ made the discovery of i-butyl alcohol in his investigations of fusel oils from potatoes and beet-sugar molasses.

The analytical chemist may regard fusel oil for all practical purposes as a mixture of water and ethyl, propyl, butyl and amyl alcohols. The quantity of ethers present, mostly amylic ethers, is usually minute. Kolbe,|| Wurtz§ and Perrot\*\* examined the ethers and fatty acids of fusel oil. Whilst in the crude product amyl alcohol preponderates, the composition of distillates varies greatly. Instances of fusel oil free, or nearly free, from amyl alcohol as reported in chemical literature, e. g., by H. Briem,†† do not bear close scrutiny. One such case‡‡ mentioned I found on consulting the original,||| to refer to a distillate. This liquid, boiling at about 100° C., consisted of ethyl, propyl and chiefly isobutyl alcohols, with only very little amyl alcohol, and had been obtained from a large quantity of fusel oil by fractional distillation with the aid of a column.

G. L. Ulex§§ described, in 1873, a valuable method of determining the amount of ethyl alcohol in fusel oil, and incidentally remarked that "wine" fusel oil contains no amyl alcohol, because

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\* Ann. Chim. phys. [3] 12 (1844). 294.

† Compt. Rend. 37 (1853), 410.

‡ Compt. Rend. 35 (1852), 310, and Ann. Chim. phys. [3] 42 (1854), 129.

| Ann. 41 (1842), 53.

§ Ann. Chim. phys. [3] 42 (1854), 129.

\*\* Compt. Rend. 45 (1857), 309.

†† Organ des Central Ver. f. Rubenzucker-Ind. Oest. Ung. Monarchie 1877, p. 180.

‡‡ Wagner's Jahresb., 1875, p. 882.

|| August Freund, J. f. pr. Chem. N. F. 12 (1875), p. 25.

§§ Dingler's polyt. Journal, 208, 379.



all of it passes over below  $130^{\circ}$  C. when subjected to distillation. Such superficial argument cannot convince the student who has ever investigated fractional distillation, especially as applied to such a complex mixture of analogous substances as represented by fusel oil. How imperfect a separation is effected by a single distillation of even so simple a mixture as amyl and ethyl alcohols, the boiling points of which are the farthest apart of all the substances concerned in this discussion, may be gathered from a communication in "A Treatise on Chemistry," by Roscoe and Schorlemmer.\* A further complication ensues when the liquid contains water, as all commercial fusel oil does, and dehydration previous to analysis is neglected. A mixture of water and amyl alcohol, † B. P.  $130^{\circ}$ , boils at  $96^{\circ}$ , and the distillate consists of two volumes of water and three of amyl alcohol; in the case of butyl alcohol, B. P.  $108^{\circ}$ , the boiling point is lowered to  $90.5^{\circ}$  and the constituents pass over in the proportion of one volume of the former to five of the latter. In the light distillates of fusel oil the amount of water may rise to considerable proportions. Where a rational separation is aimed at, complete dehydration is indispensable.

The Government chemist is chiefly concerned in a rapid determination of ethyl alcohol in fusel oil. The time-honored British method consists in shaking the sample with an equal volume of water and taking the gravity of the separated aqueous layer. Ulex‡ was the first to call attention to the serious error committed in calculating the percentage of ethyl alcohol from the gravity of the aqueous solution. He points out that commercial fusel oil is far from being a mixture of ethyl and amyl alcohols, and that the ready solubility of the lower alcohols is the cause of grave mistakes. The solubility of the alcohols chiefly concerned stands thus:

n-propyl alcohol is miscible with water in all proportions.

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\* Vol. III., p. 147.

† Pierre and Puchot, Ann. Chim. phys. [4], 22 (1868), 234.

‡ l. c.

i-butyl alcohol requires 10.5 parts of water for solution at 18° C.

i-amyl alcohol requires 39 parts of water for solution at 16.5° C.

Ulex distilled three different fusel oils with the following results :

	FUSEL OIL FROM		
	Beets.	Potatoes.	Rye.
Sp. gr. at 15° C. ....	.826	.832	.837
80-100° C. ....	13% by vol.	13% by vol.	31% by vol.
100-130° C. ....	53% “	30% “	26% “
above 130° C. ....	34% “	57% “	43% “

From these figures he concludes that two-thirds of beet fusel oil consist of the more soluble alcohols, a conclusion manifestly incorrect, as repeated fractional distillations would have yielded larger percentages of high boiling components. Neither does he mention any treatment to free the oils from water, though their gravities distinctly indicate its presence. It must be considered that he is speaking *pro domo*. However, his data were sufficient to justify his attack on the British excise method, on the basis of which a fusel oil containing eight per cent. of proof spirit had been declared to hold forty-four per cent.

According to his method 100 cc. of the sample is distilled until 5 cc. of distillate is collected. This is shaken with an equal bulk of a saturated solution of sodium chloride. If one-half or more of fusel oil is separated, it may be taken for granted that less than fifteen per cent. of proof spirit are present, *i. e.*, the sample is duty free. If, however, less or none separates, the sample under examination is shaken with an equal volume of a saturated solution of sodium chloride, which dissolves propyl and butyl alcohols much less readily than water does, and allowed to settle. The aqueous layer is subjected to distillation, and the gravity of the distillate is determined.

Alfred H. Allen\* describes a very rapid method yielding satisfactory results, when mixtures of ethyl and amyl alcohols only are concerned. After agitating the sample in a graduated tube with

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\* Commercial Organic Analysis, Vol. I. (1885), p. 179.

an equal volume of petroleum spirit, sufficient water is added to cause separation. The increase in the volume of the petroleum spirit indicates with approximate accuracy the amount of amyl alcohol.

The German Excise\* authorities employ the following tests :

1. 10 cc. of fusel oil are shaken with 30 cc. of calcium chloride solution of sp. gr. 1.225 (made from 25 grms. of anhydrous calcium chloride and 100 cc. of water). After one minute's agitation at least 7.5 cc. must remain undissolved.

2. 100 cc. of fusel oil must show a decided turbidity, when shaken for one minute with 5 cc. of distilled water.

I have had occasion to examine several samples of distillates of fusel oil. A sample from a famous German factory was anhydrous, and consisted of nothing but propyl and butyl alcohols. Another distillate from a New York City firm had a similar composition with only very little amyl alcohol. But the most interesting and somewhat surprising results were revealed on a closer examination of several samples from a factory, where large quantities of domestic and foreign fusel oils are distilled. These liquids were guaranteed to be practically free from amyl alcohol, and a chemist, presumably more obliging than erudite, certified to the fact, that they contained propyl alcohol as their chief constituent, and that on an average not more than four per cent. of water was present. In spite of this favorable composition, and though they were used in conjunction with high grade wood alcohol, these fluids were responsible for some highly objectionable phenomena in the manufacture of celluloid. The determination of their gravities showed the presence of a large amount of water. If no dehydration had taken place previous to distillation, it was to be presumed that all the alcohols of fusel oil would be present, which my analyses proved to be the case.

To determine the quantity of water, 200 cc. of the sample were shaken in a graduated cylinder with freshly calcined potassium carbonate. More carbonate was added, until no further diminution of volume took place. The gravity of the liquid was carefully

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\* Wagner's Jahresb. 1890, p. 1078.

taken both before and after this operation. All the gravities were determined by means of a pycnometer. A simple calculation gives us the percentage of water with sufficient accuracy for technical purposes.

For instance :

200 cc. Sp. gr. .8425 = 168.5 grms.  
leave 179 cc. Sp. gr. .8095 = 144.9 grms.

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23.6 grms. of water.  
= 14% by weight.

The larger quantities required for fractional distillation were dehydrated in the same manner, the operation being repeated. A further treatment with quick lime produced no decrease in the gravity. Calcium chloride cannot be recommended for quantitative work, being noticeably soluble even in the higher alcohols and thus interfering with distillation. 250 grms. of the anhydrous liquid were distilled from a flask fitted with a Glinsky column and connected with a long Liebig condenser, the rate of distillation being a drop a second. A platinum spiral was immersed in the fluid to ensure regular ebullition. In the first distillation the portions passing over between each five degrees were collected separately. These fractions were redistilled, and those portions which boiled between the same intervals of temperature were united, the interval in all subsequent distillations being two degrees. In this manner fractions boiling at 78–80°, at about 97° and 109°, and at 128–132° were obtained. The slight residue boiling above 132° possessed an odor suggestive of amyl valerate and probably consisted mainly of amylic ethers. I append the results of my analyses of four different samples.

I.

Clear yellow liquid of neutral reaction.

Sp. gr. .8425 at 18° C.

100 grms. contain 14.0 of water.

30.0 of ethyl alcohol.

14.5 of n-propyl alcohol.

25.2 of i-butyl alcohol.

15.0 of fermentation amyl alcohol.

1.3 of residue.

## II.

Clear yellowish liquid of neutral reaction.

Sp. gr. .8523 at 19.5° C.

100 grms. contain 20.0 of water.

19.4 of ethyl alcohol.

11.7 of n-propyl alcohol.

24.9 of i-butyl alcohol.

22.0 of ferm. amyl alcohol.

2.0 of residue.

## III.

Slightly cloudy liquid of brownish tinge. Reaction neutral.

Sp. gr. .8434 at 21.5° C.

100 grms. contains 18.3 of water.

15.0 of ethyl alcohol.

8.2 of n-propyl alcohol.

19.9 of i-butyl alcohol.

36.8 of ferm. amyl alcohol.

1.8 of residue.

## IV.

Colorless, clear liquid, of neutral reaction.

Sp. gr. .8630 at 16.5° C.

100 grms. contain 23.0 of water.

52.8 of ethyl alcohol.

5.7 of n-propyl alcohol.

11.0 of i-butyl alcohol.

7.0 of ferm. amyl alcohol.

.5 of residue.

It is evident that these liquids are the result of a simple distillation of fusel oil in the crudest kind of still. The temperature may never have exceeded 100°.

Kraemer and Pinner\* found in the first runnings of fusel oil thirty per cent. of water, thirty per cent. of i-butyl, twenty per cent. of ethyl, and twenty per cent. of other alcohols, a good portion of which is n-propyl alcohol. Pierre and Puchot† found in

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\* Ber. 2 (1869) 401, and 3 (1870), 75.

† Ann. Chim. phys. [4] 22 (1868), 234.

the crude fusel oils examined by them on an average 16 per cent. of water, 2.5–3 per cent. of *n*-propyl, 3–4 of *i*-butyl, and at least fifty per cent. of amyl alcohol. I learned later on that samples I. and II. had been specially redistilled, that my analyses might show more of the lower alcohols and less of amyl than otherwise would have been the case. A mixture of these distillates with methyl alcohol, in the proportions as used in practice, yields a clear camphor solution. Without the wood alcohol part of the water separates on the addition of camphor, and this behavior accounts for the disagreeable experience with these menstrua. Large blocks of celluloid, when cut into sheets, were found to be interspersed with cavities containing a liquid, which proved to be chiefly water. Their presence is easily explained when the peculiar composition of the solvent is considered. As stated, these liquids were represented to be free from amyl alcohol, and it became thus necessary to investigate the nature of the fraction 128–132°.

Its gravity was found to be .8113 at 19° C., *i. e.*, the gravity of *i*-amyl alcohol. With metallic sodium a gelatinous mass was obtained under copious evolution of hydrogen; on addition of water an oily layer collected on top of the lye. Heated with sulphuric acid and sodium acetate, an ether of the characteristic smell and boiling point of amyl acetate was produced. These tests leave no doubt as to its nature.

But the chief constituent was said to be propyl alcohol, and in view of Rabuteau's\* researches on potato fusel oil it was at first thought possible that isopropyl alcohol might be contained in considerable quantities in the fractions of low boiling points. Isopropyl alcohol is not totally freed from water even by distillation over barium oxide, as Friedel,† who was the first to prepare it from acetone, pointed out. Berthelot,‡ the discoverer of the compound, obtained it by absorbing propylene in sulphuric acid and treating the solution with water. He found the boiling point of the alcohol, which was not quite free from water, at 81–82°. The sepa-

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\* Compt. Rend. 87 (1878), 500.

† Compt. Rend. 55 (1862), 53.

‡ Ann. Chim. phys. [3] 43 (1855), 385.

ration had been effected by means of calcined potassium carbonate. Friedel's compound, boiled at 84–86°, after several rectifications over barium oxide, at 86–88°, after treatment with metallic sodium. It is to be noted that the acetone used by him was not remarkably pure, being a by-product gained in the manufacture of aniline. The subject was fully investigated by Linnemann\*, who laid especial stress on starting with pure acetone. According to his investigations the boiling points of isopropyl alcohol and its three distinct hydrates,  $3 \text{ C}_3\text{H}_8\text{O}_3 + 2 \text{ H}_2\text{O}$ ,  $2 \text{ C}_3\text{H}_8\text{O}_3 + \text{H}_2\text{O}$ , and  $3 \text{ C}_3\text{H}_8\text{O}_3 + \text{H}_2\text{O}$ , are 83–84°, 78–80°, 80° and 81° respectively. As these low alcohols absorb water, complete dehydration is rendered difficult; and as furthermore the boiling point of ethyl alcohol rises in the presence of water, it will be easily understood that a separation by fractional distillation alone must be well nigh impossible, as far as technical analysis is concerned. But a careful examination showed the entire absence of this alcohol. From each of the four samples 5 grms. of the fraction 78–80° and of intermediate fractions up to 88°, obtained by special distillations, were taken and subjected to oxidation. 5 grms. of the alcoholic liquid were dissolved in 45 grms. of water and a solution of

9.17 grms. of potassium dichromate,  
11.90 grms. of sulphuric acid,  
46.70 grms. of water,

was added, drop by drop. After complete reduction of the chromic acid the oxidation product was distilled off. Its odor was at once aldehydic and ethereal. To test for acetone, 5 cc., previously neutralized with caustic soda, were dissolved in 2 cc. of fifty per cent. alcohol and a drop of 10 per cent. caustic soda solution and a drop of pure benzaldehyde were added. After two days' standing there was no sign of the characteristic dibenzylidene acetone crystals, whilst a blank test with only 0.5 cc. of acetone yielded an abundant crop. Further tests with an alkaline sublimate solution gave likewise negative results. To a mixture of 1 cc. of  $\text{HgCl}_2$  solution (1:20 of water) and 4 cc. of alcoholic potash (1:10) 1 cc. of the liquid was added, and the whole was thoroughly shaken. Ammon-

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\* Ann. 136 (1865), 37.

ium sulphide failed to produce a precipitate in the filtered solution. Whenever alkali was added, the liquid turned first yellow, then reddish brown, and a pronounced smell of cinnamon was discernable, showing the presence of aldehyde. Ammoniacal silver solution was readily reduced. The odor of ethyl acetate could also be detected.

Rabuteau\* found no less than 150 cc. of i-propyl alcohol, boiling at 85°, in one litre of potato fusel oil of Swedish origin. Nothing further has been published on the subject, the communication in the *Bulletin de la Société Chimique* 33 (1880), 178, being nothing but an abstract from the original in the *Comptes Rendus*.

The alcohol was identified by ultimate analysis, by its conversion into acetone and by its acetate boiling at 76°. Now it is ethyl acetate that boils at 76°, whilst the isopropyl ether boils at 90° according to Berthelot† and at 90–93° according to Friedel.‡ Rabuteau's figure may be simply an error, as 106.9° instead of 116.9° for n-butyl alcohol in the same article is. It is interesting to recall the fact that the very existence of n-propyl alcohol, and as a natural consequence its presence in fusel oil, was considered doubtful as late as 1868 by Mendelejeff.§ He separated from 37 grms. of Chancel's¶ alcohol 8 grms. of water, 25 grms. of ethyl and 1 gram. of amyl alcohol. The presence of the normal alcohol in fusel oil, not only in that from the marc of grapes, was placed beyond a doubt by the researches of Pierre and Puchot\*\* and of Kraemer and Pinner.†† That Perrot‡‡ did not succeed in finding it in potato and beet fusel oils was due to his faulty method. From 60 litres he did not isolate enough of its iodide to be convinced of its presence. Without having recourse to dehydration, he separated a fraction boiling at 95°, treated it with desiccating

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\*l. c.

†l. c.

‡l. c.

§*Zeitschrift für Chem.*, 1868, p. 25.

¶*Compt. Rend.* 37 (1853), 410.

\*\**Ann. Chem. phys.* [4] 22 (1868), 234.

††*Ber.* 2 (1869), 401 and 3 (1870), 75.

‡‡*Compt. Rend.* 45 (1857), 309.



substances and converted it at once into the iodides. Yssel de Schepper\* proceeded similarly with rye fusel oil. He freed a fraction passing over between 93 and 98° from water by agitation with anhydrous sodium carbonate. The liquid thus treated distilled at 83–84°, the mixture of iodides derived from it at 72–91°. Pirre and Pucheot say of the latter, that according to their extended investigations such mixture was liable to contain the iodides of the whole series of alcohols. Yssel de Schepper remarks that his experiments make the presence of an alcohol of the propylic series in rye fusel oil very probable. Pierre and Puchot, who experimented with very large quantities of fusel oils from various sources, with the facilities of a large distillery and with improved apparatus specially designed by them, found no i-propyl alcohol. A fraction of the boiling point 85–86° was at first thought to be the iso alcohol, but after treatment with potassium carbonate it was easily further separated by distillation. Rabuteau, however, was careful to free the crude fusel oil from water. Kraemer and Pinner, who also enjoyed the advantage of collaboration with a manufacturer, were unable to find i-propyl alcohol in a portion boiling at 84–86°, obtained from the dehydrated first runnings of fusel oil by repeated fractionating. The vapor density of these products was always found to be that of ethyl alcohol. It might be objected, that any of the hydrates of i-propyl alcohol would have shown a vapor density approaching that of ethyl alcohol. But these hydrates have a lower boiling point, and Kraemer and Pinner employed excellent apparatus. Barbaglia† found in isobutyl aldehyde from Kahlbaum's factory considerable quantities of acetone. Being unable to obtain acetone from pure isobutyl alcohol under the ordinary conditions of oxidation, he ascribed its formation to the presence of large quantities of i-propyl alcohol in the commercial i-butyl alcohol, from which the aldehyde had been made. Kraemer,‡ the manager of Kahlbaum's factory, replied that the i-butyl alcohol, prepared on a large scale from the first runnings of fusel oil by a series of frac-

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\*Zeitschrift für Chem., 1868, p. 520.

† Ber. 6 (1873), 1064.

‡ Ber. 7 (1874), 252.

tional distillations, boiled at 106–109°, and that the absence of any noticeable quantity of i-propyl alcohol was further proved by converting the alcohol into its bromide. He showed that acetone was a constant product of oxidation of i-butyl alcohol under the conditions adhered to in their process of manufacturing i-butyl aldehyde. Lipp\* described a method by which the formation of acetone may be almost wholly avoided. If we consider Rabuteau's data in the light of these facts, we are forced to the conclusion that the presence of such large quantities of i-propyl alcohol in potato fusel oil of Swedish origin is somewhat doubtful. The boiling point of 85° cannot assure us of the purity of the alcohol; the ultimate analysis is of little value, as any number of possible and probable mixtures can give results in accordance with the percentage composition of propyl alcohol; the boiling point of i-propyl acetate is not 76°; the formation of acetone is not sufficient proof, until it is shown that it is formed in such quantities as to preclude the possibility that it may owe its origin to a small quantity of i-butyl alcohol. It would have been desirable to learn how the acetone was identified. So far all the alcohols isolated from the fermentation products of saccharine liquids, about which there can be no reasonable doubt, are primary alcohols. They are methyl, ethyl, n-propyl, n- and i-butyl and i-amyl alcohols. Normal butyl alcohol was found by Claudon and Morin† in the heavy oils of French brandy (cognac), of which, however, it is not a normal constituent, but its presence is rather due to a secondary and objectionable fermentation. Morin‡ proved its absence in normal brandies. Methyl alcohol is a product of the spontaneous fermentation of sugar cane juice in tropical climates, as discovered by Marcano.§ The yield of ethyl alcohol in this fermentation falls below the quantity produced by common yeast. The first runnings are methyl alcohol; the tailings are perfectly free from the higher alcohols and consist of a peculiar oily acid of disagreeable odor. Cultivations of the ferment in pure sugar solutions yield the same

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\* Ann. 205 (1880), 1.

† Compt. Rend. 104 (1887), 1187.

‡ Compt. Rend. 105 (1887), 1019.

§ Compt. Rend. 108 (1889), 955.

products. We are told that the domestic ardent spirits of our Southern neighbors are of the vilest quality. Marcano's research sheds a flood of light on this subject. Kraemer and Pinner\* in 1869 expressed the opinion that methyl and hexyl alcohols might be found among the alcohols of fermentation. As far as methyl alcohol is concerned, their prediction was verified by Marcano's discovery. But Faget's† statements, who in 1853 isolated a substance from a fusel oil formed in the fermentation of grape skins, which he was inclined to regard as hexyl alcohol, have never been confirmed. Wurtz‡ demonstrated that potato and beet fusel oils contain no alcohols of any higher series than the pentylic. Perrot|| was unable to find any hexyl alcohol in the same oils. Clandon and Morin§, and Morin\*\*, who made the most thorough examinations of fusel oils extracted from large quantities of wine-brandy, report no hexyl alcohol.

It is to be hoped that Swedish potato fusel oil will be the subject of further investigation. If it contains 150 cc. of isopropyl alcohol in each liter, there can be no difficulty in establishing this fact beyond any doubt. It is only necessary to subject the thoroughly dehydrated product to repeated fractional distillations and convert the portion boiling below 85° into the acetates. The difference in the boiling points of the acetates is about the same as in the case of the iodides, while the regeneration of the alcohols from the acetates is a much easier task. If the alcohol regenerated from an acetate of correct boiling point is transformed into acetone by oxidizing agents and if this alcohol furnishes a benzoate,†† which by heating is decomposed into propylene and benzoic acid, the existence of i-propyl alcohol in the original substance will be proved. Or the peculiar behavior of i-propyl benzoate above referred to may be utilized for the separation of i-propyl alcohol.

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\*Ber. 2 (1869), 401.

†Compt. Rend. 37 (1853), 730.

‡Ann. Chim. phys. [3] 42 (1854), 129.

||Compt. Rend. 45 (1857), 309.

§Compt. Rend. 104 (1887), 1187.

\*\*Compt. Rend. 105 (1887), 1019.

††Linnemann, Ann. 161 (1872), p. 51.

## ANALYSES OF GLASS USED IN THE MANUFACTURE OF INCANDESCENT ELECTRIC LAMPS.

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BY DURAND WOODMAN, PH. D.

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In the manufacture of Incandescent Lamps there is a certain percentage of loss due to what may be termed spontaneous breakage; lamps, apparently well made, cracking at some part without having been subjected to any shock or blow.

A reasonable amount of loss in this way is unavoidable, from one cause or another, but when a certain limit is exceeded some special cause is suspected, as carelessness in the glass blowing department, want of sufficient annealing, and the like.

The difficulty often passes by during the efforts to control it, without any satisfactory explanation either of the trouble or the cause of its cessation.

The lamp bulbs may crack (a) where the platinum wires are sealed in, or (b) where the "stem" carrying the wires and carbon filament is joined to the bulb proper, or occasionally (c) where the exhausting tube is sealed on at the apex of the bulb.

In addition to the internal strains existing in any such glass work, the lamp bulb, when finished, is subjected externally to the full atmospheric pressure and to sudden heat strains from the instantaneous turning on of current, as occurs in perhaps a majority of lamps in use.

This combination of strains being considered, it is evident that differences in the glass used for the bulb and stem and consequent differences of coefficients of expansion which, in ordinary glass work would not be of importance, will become manifest here.

Glass blowers know that similar grades of glass should be used together, but they are able to work up grades of glass differing in composition more than is permissible in incandescent lamps.

I have had an opportunity to make some analyses of the glass used at a time when the percentage of spontaneous breakage was abnormally large, and when every care in making up the lamps, annealing, etc., was unavailing.

*Analysis of Glass Rod, Tube and Lamp Bulb.*

	Rod, 108.	Tube, 109.	Lamp Bulb, 112.
K <sub>2</sub> O	1.38	4.20	2.32
Na <sub>2</sub> O	15.06	9.05	14.50
CaO	2.15	—	6.40
MgO	0.70	—	0.93
MnO	1.02	trace.	trace.
Fe <sub>2</sub> O <sub>3</sub>		1.65	1.45
Al <sub>2</sub> O <sub>3</sub>			
PbO	16.81	19.83	1.39
SiO <sub>2</sub>	63.44	65.16	72.35
Cr <sub>2</sub> O <sub>3</sub>	trace.	trace.	trace.
	100.56	99.89	99.34

These results explained the trouble from breakage in lamps made up from these grades of glass.

During the investigation, samples of glass of lamps by several different makers were analyzed; one of them, an English lamp gave the following figures :

*Analyses of Bulb and Stem of English Incandescent Lamp.*

	Bulb 115.	Stem 116.
K <sub>2</sub> O .....	5.20	6.14
Na <sub>2</sub> O .....	9.20	8.10
CaO .....	5.41	5.05
MgO .....	—	trace
Fe <sub>2</sub> O <sub>3</sub> .....	—	} 1.10
Al <sub>2</sub> O <sub>3</sub> .....	3.70	
PbO .....	2.90	10.68
SiO <sub>2</sub> .....	73.10	68.24
	99.51	99.31

This bulb was a very brilliant clear glass. While nothing is known as to the percentage of breakage in the manufacture of these lamps, it is evident that no special effort has been made to use the same glass in both parts of the lamp. Another lamp (of

American manufacture) was examined and found to be of the same glass throughout, as shown below :

	Bulb 118.	Stem 114.
K <sub>2</sub> O.....	7.17	6.91
Na <sub>2</sub> O.....	6.43	5.89
Al <sub>2</sub> O <sub>3</sub> .....	0.39	1.98
PbO.....	18.70	17.14
SiO <sub>2</sub> .....	66.22	65.80
CaO.....	0.45	1.25
MnO.....	} traces.	traces.
MgO.....		
Fe <sub>2</sub> O <sub>3</sub> .....		
	99.36	98.97

It should be said here that no proof has been obtained as to the possibility that some glasses of different composition may have similar coefficients of expansion, certain constituents compensating each other, but as it is a simple matter to obtain glass of practically the same composition for all parts of a lamp or any other complex glass work.

Problems connected with the coefficient of expansion need not necessarily be taken into consideration.

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## REPORT OF THE COMMITTEE ON SPELLING AND PRONUNCIATION OF CHEMICAL TERMS.\*

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During the last four years, your committee has sought to obtain from the members of this Section, from leading American Philologists, and from American Chemists in general, an exhaustive and thoroughly representative expression of opinion on the questions coming within the scope of its commissions, which has been essentially the attainment of uniformity in the orthography and pronunciation of the terms used in our science.

Three preliminary reports were distributed to American Chem-

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\* From advance sheets of the Proceedings of the American Association for the Advancement of Science, Washington Meeting, 1891.

ists in the years 1889, 1890 and 1891, inviting extended criticism and suggestion.

The substance of the replies to these was carefully digested and submitted to the Chemical Section each year for detailed discussion and decision.

The present and final report of your committee embodies the results of these four years of correspondence and discussion, as completed by the sectional action at the present meeting of the Association. It is presented in the hope that all chemists, especially those engaged in teaching, will cordially unite in the efforts to bring about the desired uniformity in usage.

The reasons for the adoption of a few more radical changes in our nomenclature are to be found in the report for 1890. Those specially interested in the subject who have not attended the recent sessions of the Association may freely correspond with individual member of the Committee, who will gladly furnish more detailed explanation of the principles involved.

The following summary of rules is not to be regarded as final. Your committee recognize the fact that after a fair trial for a decade or even less, certain modifications will in all probability be generally regarded as desirable.

In conclusion the committee express their sincere thanks to their many colleagues throughout the land, who have so promptly and fully responded to the successive requests for data, suggestions and opinions.

T. H. NORTON,  
EDWARD HART,  
H. CARRINGTON BOLTON,  
JAS. LEWIS HOWE.

## RULES FOR THE ORTHOGRAPHY AND PRONUNCIATION OF CHEMICAL TERMS.

### GENERAL PRINCIPLES OF PRONUNCIATION.

1. The pronunciation is as much in accord with the analogy of the English language as possible.
2. Derivatives retain as far as possible the accent and pronunciation of the root word.
3. Distinctly chemical compound words retain the accent and pronunciation of each portion.
4. Similarly sounding endings for dissimilar compounds are avoided (hence *-id*, *-ite*).

### ACCENT.

In polysyllabic chemical words the accent is generally on the antepenult; in words where the vowel of the penult is followed by two consonants, and in all words ending in *-ic* the accent is on the penult.

### PREFIXES.

All prefixes in strictly chemical words are regarded as parts of compound words, and retain their own pronunciation unchanged (as, *ă'ceto-*, *ă'mido-*, *ă'zo-*, *hŷ'dro-*, *ī'so-*, *nī'tro*, *nītrō'so-*).

### ELEMENTS.

In words ending in *-ium*, the vowel of the antepenult is short if *i* (as *irī'dium*), or *y* (as *dīdŷ'mium*, or if before two consonants (as *că'lcium*), but long otherwise (as *tītā'nium*, *sělē'nium*, *chrō'mium*).

<i>al'ū'minum</i>	<i>chrō'mium</i>	<i>ī'ōdīn</i>	<i>nī'trogen</i>
<i>a'ntimony</i>	<i>cō'balt</i>	<i>irī'dium</i>	<i>ō'smium</i>
<i>a'rsēnic</i>	<i>colŭ'mbium</i>	<i>iron</i>	<i>ō'xygen</i>
<i>bā'rium</i>	<i>co'pper</i>	<i>lă'nthanum</i>	<i>pallā'dium</i>

*Fāte*, *făt*, *fār*, *mēte*, *mět*. *pine*, *pīn*, *marīne*, *nōte*, *nőt*, *möve*, *tūbe*, *tüb*, *rūle*, *mŷ*, *ŷ* = *ī*.

Primary accent ; " secondary accent    N. B.—The accent follows the vowel of the syllable upon which the stress falls, but does not indicate the division of the word into syllables.



bi'smuth (biz)	dīd'y'mium	lead	phōs'phorus
bō'ron	e'rbium	lī'thium	plā'tinum
brō'mīn	flū'orīn	magnē'sium	potā'ssium
cā'dmium	gā'llium	(zhium)	rhō'dium
cā'lcium	germā'nium	ma'nganese	rubī'dium
ca'rbon	glū'cinum	(eze)	ruthē'nium
cē'rium	gold	me'rcury	samā'rium
cē'sium	h'y'drogen	mōly'bdenum	scā'ndium
chlō'rin	ī'ndium	nī'ckel	sēlē'nium
sil'licon	sū'lfur	thō'rium	vānā'dium
silver	tāntalum	tin	ytte'rbium
sō'dium	tellū'rium	tītā'nium	ŷ'ttrium
strō'ntium	te'rbium	tū'ngsten	zinc
(shium)	thā'llium	ūrā'nium	zircō'nium

Also: āmmō'nium, phosphō'nium, hā'logen, cyā'no-gen, āmī'dogen.

Note in the above list the spelling of the halogens, cesium and sulfur; f is used in the place of ph in all derivatives of sulfur (as sulfuric, sulfite, sulfo-, etc.)

#### TERMINATIONS IN -ic.

The vowel of the penult in polysyllables is short (as cyā'nic, fūmā'ric, arsē'nic, silī'cic, iō'dic, bū'ty'ric), except (1) u when not before two consonants (as mercū'ric, prū'ssic), and (2) when the penult ends in a vowel (as benzō'ic, olē'ic); in dissyllables it is long except before two consonants (as bō'ric, cī'tric).

Exceptions: acē'tic or acē'tic.

The termination -ic is used for metals only where there is a contrast with -ous (thus avoid aluminic, ammonic, etc.).

#### TERMINATIONS IN -ous.

The accent follows the general rule (as plā'tinous, sū'lfurous, phō'sphorous; cōba'litous). Exception: acē'tous.

Fāte, fāt, fār, mēte, mēt, pīne, pīn, marīne, nōte, nōt, mōve, tūbe, tūb, rūle, mŷ, ŷ = ī

Primary accent ; " secondary accent. N. B.—The accent follows the vowel of the syllable upon which the stress falls, but does not indicate the division of the word into syllables.

TERMINATIONS IN **-ate** and **-ite**.

The accent follows the general rule (as *ă'cetāte*, *vă'nadāte*); in the following words the accent is thrown back (as *ă'bietāte*, *ă'lcoholāte*, *ă'cetonāte*, *ă'ntimonite*).

TERMINATIONS IN **-id** (FORMERLY **-ide**).

The final **e** is dropped in every case and the syllable pronounced **id** (as *chlō'rīd*, *ī'odīd*, *hŷ'drīd*, *ŏ'xīd*, *hŷdrŏx'īd*, *sŭ'l-fīd*, *ă'mīd*, *ă'nīlīd*, *mŭrĕ'xīd*).

TERMINATIONS IN **-ane**, **-ene**, **-ine** and **-one**.

The vowel of these syllables is invariably long (as *mĕ'thāne*, *ĕ'thāne*, *na'phthalēne*, *a'nthracēne*, *prŏ'pine*, *quī'nōne*, *ă'cetōne*, *kĕ'tōne*).

A few dissyllables have no distinct accent (as *benzene*, *xy-lēne*, *cĕtēne*).

The termination **-ine** is used only in the case of doubly unsaturated hydrocarbons, according to Hofmann's grouping.

TERMINATIONS IN **-in**.

In names of chemical elements and compounds of this class, which includes all those formerly ending in **-ine** (except doubly unsaturated hydrocarbons) the final **e** is dropped, and the syllable pronounced **-in** (as *chlō'rīn*, *brŏ'mīn*, etc., *ă'mīn*, *ă'nīlīn*, *mo'rphīn*, *quī'nīn*, *vanī'llīn*, *alloxă'ntīn*, *absi'nthīn*, *emŭ'lsīn*, *că'ffeīn*, *cŏ'caīn*).

TERMINATIONS IN **-ol**.

This termination, in the case of specific chemical compounds, is used *exclusively* for alcohols, and when so used is never followed by a final **e**. The last syllable is pronounced **-ol** (as *glŷ'cŏl*, *phĕ'nŏl*, *crĕ'sŏl*, *thŷ'mŏl* (ti), *glŷ'cerŏl*, *quī'nŏl*).

Exceptions: *ălcohŏl*, *argŏl*.

*Fāte*, *fāt*, *fār*, *mēte*, *mĕt*, *pine*, *pīn*, *marine*, *nōte*, *nŏt*, *möve*, *tŭbe*, *tŭb*, *rŭle*, *mŷ*, *ŷ* = *ĭ*.

Primary accent ; " secondary accent. N. B.—The accent follows the vowel of the syllable upon which the stress falls, but does not indicate the division of the word into syllables.

## TERMINATIONS IN -ole.

This termination is always pronounced -ole, and its use is limited to compounds, which are not alcohols (as ħ'ndōle).

## TERMINATIONS IN -yl.

No final e is used; the syllable is pronounced yl (as ā'cetŷl, ā'mŷl, cē'rotŷl, cē'tŷl, ě'thŷl).

## TERMINATIONS IN -yde.

The y is long (as ā'ldehŷde).

## TERMINATIONS IN -meter.

The accent follows the general rule (as hydrō'meter, barō'meter, lactō'meter).

Exception: words of this class used in the metric system are regarded as compound words, and each portion retains its own accent (as cēntime''ter, mīllime''ter, kŷlome''ter).

## MISCELLANEOUS WORDS

which do not fall under the preceding rules.

Note the spelling: albumen, albuminous, albuminiferous, asbestos, gramme, radical.

Note the pronunciation: a'lkaline, a'lloy (n. & v.) a'llo-tropy, a'llo-tropism, i'somerism, pō'lymerism, apparā'tus (sing. & plu.) āqua regia, barŷ'ta, cēntigrade, co'n-centrated, crystallīn or crystalline, electrō'lysis, lŷter, mō'lecule, mōlē'cular, nō'menclā'ture, olē'fi-ant, qua'ntivā'lence, vā'lence, ū'nivā'lent, bī'vā'lent, trivā'lent, qua'drivā'lent, tŷ'trate.

Fāte, fāt, fār, mēte, mēt, pine, pln. marine. nōte, nōt. mōve, tūbe, tūb, rūle, mŷ, ŷ = ĭ.

' Primary accent; '' secondary accent. N. B.—The accent follows the vowel of the syllable upon which the stress falls, but does not indicate the division of the word into syllables.

A LIST OF WORDS WHOSE USE SHOULD BE AVOIDED IN  
FAVOR OF THE ACCOMPANYING SYNONYMS.

<i>For</i>	<i>Use</i>
beryllium	glucinum
niobium	columbium
thein	caffein
titer (n.)	strength or standard
titer (v.)	titrate
monovalent	univalent
divalent, etc.	bivalent, etc.
quantivalence	valence
sodic, calcic, zincic, nick- elic, etc., chlorid, etc	sodium, calcium, zinc, nickel, etc., chlorid, etc. vid. terminations in -ic supra.
arsenetted hydrogen	arsin
antimonetted hydrogen	stibin
phosphoretted hydrogen	phosphin
sulfuretted hydrogen, etc	hydrogen sulfid, etc.
alkylogens	alkylhaloids
benzol	benzene
toluol, etc.	toluene, etc.
pyrocatechin	catechol
resorcin	resorcinol
*hydroquinone (and hy- drochinon	quinol
orcin	orcinol
hydrophlorone	phlorol
phloroglucin	phloroglucol
quercite	quercitol
pinite	pinitol
glycerin	glycerol
erythrite, erythroglucin, eryglucin, erythroman- nite, phycite.	erythrol

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Fäte, făt, fär, mēte, mět, pine, pĭn, marine, nōte, nőt, möve,  
tūbe, tŭb, rūle, mŷ, ȳ = ĭ.

'Primary accent ; " secondary accent. N. B.—The accent fol-  
lows the vowel of the syllable upon which the stress falls, but does  
not indicate the division of the word into syllables.

\*Regarding this and the following words, cf J Chem Soc. XLI, p. 248

mannite	mannitol
dulcite	dulcitol
sorbite	sorbitol
furfuro	furfuraldehyde
fucusol	fucusaldehyde
anisol	methyl phenate
phenetol	ethyl phenate
anethol	methyl allyl-phenol

NOTE.—It has been suggested that the words qualitative and quantitative could be advantageously replaced by qualitative, and quantitative, deriving the terms from the Latin adjectives instead of the nouns, as has been done in the case of rotary instead of rotatory, agriculturist instead of agriculturalist, etc. The Section regards this change as eminently desirable, but on account of the extended use of the words outside of chemistry, delays action until the opinions of those in allied branches have been obtained.

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Fâte, fât, fâi, mête, mêt, pine, pîn, marine, nôte, nôt, möve, tûbe, tûb, rûle, mÿ, ÿ = i

Primary accent ; " secondary accent. N. B.—The accent follows the vowel of the syllable upon which the stress falls, but does not indicate the division of the word into syllables.

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#### BIBLIOGRAPHY OF RECENT WORK ON CHEMICAL NOMENCLATURE AND PRONUNCIATION.

Reports of the Committee on Spelling and Pronunciation of Chemical Terms. Proceedings of the American Association for the Advancement of Science, 1889, 1890, 1891.

Reports of the Committee appointed for the purpose of drawing up a statement of the varieties of Chemical Names which have come into use, for indicating the causes which have led to their adoption, and for considering what can be done to bring about some convergence of the views on Chemical Nomenclature obtaining among English and Foreign Chemists. Proceedings of the British Association for the Advancement of Science, 1883, 1884 and 1885.

Instructions to Abstractors on Nomenclature and Notation. Jour. Chem. Soc., 58, p. 53 (1890).

Report of the Committee on Nomenclature and Notation. Journal of the American Chemical Society, 8, 116 (1886).

**Abstracts of American Patents Relating to Chemistry.**

*(From the U. S. Patent Office Gazette.)*

*Issued March 1, 1892.*

**469,704.**—Method of manufacturing lithographic plates. Oskar Kindermann, Leipsic, Germany.

Zinc sheets are treated with a mixture of zinc chloride, stannic chloride, nitric acid, hydrochloric acid and water.

**469,718.**—Apparatus for the preparation of wort. Carl Roch, Chicago, Ill.

**469,749.**—Furnace for burning granular fuel. Charles R. Penfield, Duluth, Minn.

**469,752.**—Flour bolt. Charles A. Smith, Jackson, and Myron W. Clark, Parma, Mich.

**469,764.**—Dessicating closet. James A. Wills, Philadelphia, Pa.

**469,770.**—Apparatus for purifying water. Francis A. Bunnell, Syracuse, N. Y.

**469,777.**—Production and manufacture of pure asphaltum from natural asphalt. Henry A. Diehl, San Francisco, Cal.

In this process the asphalt is melted in a closed retort and the mineral impurities separated by sedimentation.

**469,788.**—Apparatus for removing vegetable matter from wool. Ludwig Kern, Hamburg, Germany.

**469,811.**—Apparatus for vaporizing oil. Joseph A. Aldridge, Indianapolis, Ind.

**469,820.**—Regenerative hot blast stove. George W. McClure and Carl Amsler, Pittsburg, Pa.

**469,822.**—Apparatus for cleaning wool or other material by use of steam or other fluid.

**469,826.**—Hot blast stove. George W. McClure, Pittsburg, Pa.

**469,847.**—Process of purifying illuminating gas. Julius Wiesender, San Francisco, Cal.

**469,851.**—Malting apparatus. August Deininger, Berlin, Germany.

**469,857.**—Method of and apparatus for heating with fluid fuel. William A. Koneman, Chicago, Ill.

**468,858.**—Process of manufacturing fuel gas. William A. Koneman, Chicago, Ill.

**469,859.**—Method of burning coal slack. William A. Koneman, Chicago, Ill.

**469,860.**—Apparatus for utilizing waste heat. William A. Koneman, Chicago, Ill.

- 469,866.—Coke oven.  
 469,867.—Apparatus for quenching coke. } Thomas R. Osbourn,  
 469,868.—“ “ “ “ } Philadelphia, Pa.  
 469,925.—Process of galvanizing metal tubes or bars. Thomas L. Thomas and Joseph B. Hillman, Prince's End, Eng.  
 469,945.—Absorber for ammonia refrigerating and ice making apparatus. Nils Johnson, St. Louis, Mo.  
 469,954.—Sizing compound. Alois Steinhauser, Fall River, Mass.  
 469,960.—Mercury column for ascertaining pressures. Almon B. Calkins, New York, N. Y.  
 469,999.—Ice machine. Florence W. Hoos and Emil Mann, Philadelphia, Pa.  
 470,004.—Filtering faucet. Henry H. Luse, San Francisco, Cal.  
 470,007.—Method of producing gas. Anthon W. Putman-Cramer, Brooklyn, N. Y.  
 470,012.—Method of producing photo-mechanical printing plates. Ludwig Schaefer, Heilbraun, Ger.  
 470,040.—Apparatus for the manufacture of gas. Jesse A. Dubbs, Allegheny, Pa.  
 470,060.—Vacuum evaporating pan. Samuel L. Lillie, Philadelphia, Pa.  
 470,077.—Grain scouring, polishing and separating machine. George E. Russel, Memphis, Tenn.  
 470,115.—Apparatus for coating paper or other fabrics. George I. Feldon, Lambeth, Eng.  
 470,121.—Apparatus for ageing whisky. John H. Haligan, Huntsville, Tex.  
 470,188.—Hydrocarbon oil vaporizer and burner. George Botsford, New Haven, Conn.  
 470,140.—Method of treating cereals and products. Emory V. Donelson, Baltimore, Md.  
 470,159.—Method and apparatus for reducing natural or artificial bituminous rock. Henry J. Warren, Buffalo, N. Y.

*March 8, 1892.*

- 470,171.—Smoke, consuming or preventing furnace. Judson A. Baldwin, Benton Harbor, Mich.  
 470,181.—Purification of brine. Caleb G. Collins, Kearney, N. J.  
 An electric current forming an electromotive force, not exceeding two and one-half volts, is used in this method for the production of ozone.  
 470,209.—Process of amalgamating gold or silver with mercury. Butler G. Noble, Brooklyn, N. Y.  
 470,260.—Electric Battery. Vincenzo Riatti, Milan, Italy.

**470,277.**—Mode of hardening steel articles. William H. Wright, Buffalo, N. Y.

**470,338.**—Process of manufacturing artificial stones. Charles Genze, Berlin, Ger.

Powdered silicic acid is mixed with lime, and to the resulting product, stone material is added and then cast in molds, dried, subjected to high pressure in a steam boiler and finally treated with a bath of calcium chloride.

**470,355.**—Filter. John Sutton, Islip, N. Y.

**470,361.**—Process of washing yeast. Adolph Kliemetschek, New York, N. Y.

**470,384.**—Process of treating copper matte. Pierre Mauhes, Lyons, France.

**470,420.**—Furnace for burning liquid fuel. Stephen Cox, Jr., Bridgeton, N. J.

**470,424.**—Device for moistening in. E. M. Krazer, Orange, N. J.; F. Thurman, Chicago, Ill.

**470,425.**—Ozone machine. Frederick M. Gunnbacher, New York, N. Y.

**470,447.**—Method for the purification of alcoholic liquids. Paul C. Rosseau and Marie J. de Chantirac, Paris, and Marie J. D. A. De Lu Baume, Tourtom, France.

Alcoholic liquids are treated with a basic tartrate, and subsequently with a hyposulphite.

**470,451.**—Manufacture of compounds of pyroxyline. August Seher, Newark, N. J.

**470,455.** ) Magnetic ore separator. Charles T. Thompson and Richard

**470,456.** ) H. Sanders, Philadelphia, Pa.

**470,476.**—Evaporating apparatus. Thomas Craney, Bay City, Mich.

**470,481.**—Blast furnace and means for operating the same. John Gill, Edinburgh, Scot.

**470,501.**—Smoke consuming furnace. Bernhard Müller, Chemnitz, Ger.

**470,506.**—Coke oven. Johannes Reiter, Aix-la-Chapelle, Ger.

**470,511.**—Discharge trough for smelting furnaces. Adam J. Schumacher, Butte City, Mont.

**470,548.**—Evaporating pan. Jay B. Copeland, Punta Gorda, Honduras.

**470,580.**—Pneumatic malting apparatus. Friedrich Knütel, Charlottenburg, Germany.

**470,587.**—Ore washer. Samuel C. McLanahan and William F. Kirk, Hollidaysburg, Pa.

**470,606.**—Process of treating iron. Richard Southerton, Birmingham, Eng.

Briquettes or balls of emery, ammonia, alum and lime, are mixed with the ore and the iron reduced to its metallic state in a furnace.



**470,620.**—Filter. William Hilton, Reynoldsville, Pa.

**470,621.**—Treatment of beer. Leopold Hoff, Hamburg, Ger.

The beer is distilled and the condensed water condensed back into the boiling liquid. It is then cooled, filtered, treated with carbonic acid gas and, finally, aromatic substances are added to give the special character of the beer.

**470,629.**—Apparatus for making illuminating gas. Thomas H. Paul, Frostburg, Md.

**470,635.**—Apparatus for making sodium bicarbonate. George Bell, Sandown Lane, Wavertree, Eng.

**470,640.**—Process of reducing iron ore. Edward E. Graff, Pittsburg, Pa.

**470,644.**—Converter for copper ores. Pierre Mauhes, Lyons, France.

*Issued March 15, 1892.*

**470,698.**—Apparatus for moistening air. Emil Mertz, Basle, Switzerland.

**470,711.**—Hydrocarbon-burner. Carl Siemens, St. Petersburg, Russia.

**470,712.**—Metallurgical furnace. Carl Siemens, St. Petersburg, Russia.

**470,713.**—Method of working open hearth furnaces. Carl Siemens, St. Petersburg, Russia.

**470,714.**—Solution of lactic acid in oils and fats. Adolph Sommer, Berkeley, Cal.

**470,715.**—Process of dissolving lactic acid in oils and fats. Adolph Sommer, Berkeley, Cal.

The process consists in digesting conc. lactic acid with the oil or fat in the presence of a dehydrating agent.

**470,781.**—Ore concentrator. Gustavus L. Cudner, New York, N. Y.

**470,792.**—Galvanic battery. Francis H. Root, Chicago, Ill.

**470,823.**—Apparatus for cooling hot liquid sugars. Henry Heide, New York, N. Y.

**470,902.**—Method of and apparatus for producing clear wort. Gustav Sobotka and Adolph Ktemetschek, New York, N. Y.

**470,911.**—Desulphurizing oil. Jesse A. Dubbs, Allegheny, Pa.

**470,920.**—Process of making oxymethoxybenzoic acid. Bueno R. Seifert, Radebeul, Germany.

An aqueous solution of guaiacol or eugenol is made with an alkali, the water is then evaporated, and the residual dry salt is treated with  $\text{CO}_2$  under pressure and heated at a temperature of over  $100^\circ \text{C}$ .

**470,921.**—Apparatus for separating precious metals by amalgamation from ores or materials containing them. Richard E. Schill, London, Eng.

**470,922.**—Manufacture of filaments for incandescent lamps. Thomas A. Edison, Menlo Park, N. J.

Sheets of paper are heated with hydrofluoric acid and filaments cut from the cemented sheets.

**470,925.**—Manufacture of filaments for incandescent electric lamps. Thomas A. Edison, Llewellyn Park, N. J.

A number of fibres are united into one by means of a carbonizable cement and the filament then carbonized.

**470,929.**—Magnetic separator. Thomas A. Edison, Llewellyn Park, N. J.

**470,966.**—Disinfecting apparatus. Frederick André, Hildesheim, Ger.

**470,974.**—Process of purifying water gas. Henry S. Blackmore, Mount Vernon, N. Y.

The gas is passed over and through caustic alkali in a fused state to remove carbonic oxide.

**471,088.**—Coke-oven. Richard de Soldenhoff, Cardiff, Eng.

**471,060.**—Method of treating cane juice and other saccharine liquors. Henry E. Niese, Jersey City, N. J.

**471,065.**—Apparatus for galvanizing sheet metal. Moses Baylies, London, Eng.

**471,081.**—Plastering Composition. Walter Robinson, Onondaga, N. Y.

*March 22, 1892.*

**471,103.**—Ore triturating and amalgamating apparatus. Gustavus L. Cudner, New York, N. Y.

**471,147.**—Manufacture of pigments. George W. Scollay, New York, N. Y.

Method for oxide of iron pigments.

**471,163.**—Material for the treatment of walls. George H. Wooster, New York, N. Y.

The composition consists of plaster of paris, alum, a fibrous material and ground marble.

**471,174.**—Process of concentrating ores. Charles B. Hebron and Carrie J. Everson, Denver, Col.

**471,182.**—Thermostatic regulator. Edwin C. Merrill, Allegheny, Pa.

**471,186.** ) Art of producing colored photographs, James W. McDonough,

**471,187.** ) Chicago, Ill.

**471,191.**—Combination crayon. William Q. Prewitt, Lexington, Ky.

**471,229.**—Evaporating pan. Lorin R. Tabor, Westford, Vt.

**471,236.**—Liquid substitute for eggs. John E. Furber, Lawrence, Mass.

A liquid compound consisting of an emulsion made of soluble albumen, water, animal or vegetable oil, sodium chloride, and sodium bicarbonate with a suitable coloring matter, combined with a second liquid similar to the above but without the coloring matter.

**471,258.**—Ore concentrator. James M. Thompson, San Francisco, Cal.

**471,261.**—Apparatus for purifying, sterilizing and filtering drinking water. Simeon L. West, Washington, D. C.

- 471,264.**—Ore roasting furnace. Horace F. Brown, Butte City, Mont.
- 471,268.**—Ore conveyor and method of arranging ore thereon. Thomas A. Edison, Llewellyn Park, N. J.
- 471,275.**—Gas burner for furnaces. James S. Rogers, Saratoga Springs, N. Y.
- 471,284.**—Machine for removing oil from tin plate. David Walters and Isaac L. Morris, Cleveland, Ohio.
- 471,287.**—Method of and apparatus for making wall paper. George K. Birge, Buffalo, N. Y.
- 471,288.**—Apparatus for marbleizing glass, paper and the like. Abraham Butterfield, Trenton, N. J.
- 471,291.**—Apparatus for destructive distillation of mineral oils. John Laing, Edinburgh, Scotland.
- 471,294.**—Method of and apparatus for purifying and regulating the temperature of air. Gustav Sobotka and Adolph Kliemetschek, New York, N. Y.
- 471,299.**—Annealing furnace. Olof J. Winlund and August L. Larson, Worcester, Mass.
- 471,306.**—Process of making nitrogenous fertilizers. Joseph Van Ruymbeke, Chicago, Ill.
- 471,309.**—Process of fermenting. Carl Funk, Charlottenburg, Ger.
- 471,314.** } Temperature regulator. James F. McElroy, Albany, N. Y.  
**471,315.** }
- 471,318.**—Apparatus for separating and purifying middlings. Alphons Steiger, London, Eng.
- 471,319.**—Concentrator. James Tulloch, Angel's Camp, Cal.
- 471,322.**—Clay separator. Charles A. Wyman, Hutchinson, Minn.
- 471,323.**—Process of separating oily inks from gauze. Jesus Castaneda, Mexico, Mexico.
- 471,335.**—Process and apparatus for manufacturing pure yeast. Gaston Guignard, Paris.
- A sweet wort is sterilized and then inoculated with pure yeast. During the fermentation sterilized air is blown in by which the production of is yeast increased. The yeast is then separated from the wort and incorporated with a gelatined or gelled wort. The operations are conducted out of contact with unsterilized air.
- 471,343.**—Artificial antiseptic sponge. Alexander Pochl, St. Petersburg, Russia.
- 471,361.**—Gas generator and burner. James S. Rogers, Saratoga Springs, N. Y.
- 471,367.**—Amalgamator for fire-milling gold ore. Alfred Woodhouse, Brengaster, Woking, Eng.
- 471,385.**—Filter. John M. Holt, Manchester, Va.

**471,398.**—Apparatus for the manufacture of gas. James S. Rogers and James H. Baker, Saratoga Spring, N. Y.

**471,422.**—Pyroxyline varnish. Julia Hale, Crawford, N. J.

A thin solution of pyroxyline in a menstruum of amyl acetate, naphtha, and a "light solvent."

**471,428.**—Process of chloridizing gold ores. Maximilian J. Hartung, Sydney, New South Wales.

The process consists in roasting the ores "and subjecting them to the action of plumbates of the alkaline earth, metals and hydrochloric acid, whereby chlorine is set free to combine with the contained metal."

**471,437.**—Apparatus for coating metal plates with tin. Philip Rogers, Swansea, and John Player, Clydach, Eng.

**471,438.**—Composition of matter for pencils or crayons. Gustav Schwurzwald, New York, N. Y.

The comp. comprises paraffine wax, dammar gum, naphthol, bronze powder, potassium bichromate, and pulv. mica.

**471,454.**—Process of and apparatus for bleaching by electrolysis. Albert E. Woolf, New York, N. Y.

**471,496.**—Filter. Frederic C. Weir and Henry B. Furniss, Cincinnati, Ohio.

**471,505.**—Apparatus for vaporizing and burning hydrocarbon oils. Rudolph Cornader, Erie, Pa.

**471,520.**—Process of making piperazin, Wilhelm Majest, Berlin, Ger.

The process "consists in isolating the piperazin in a compound thereof by means of an alkaline solution, distilling the piperazin into a suitable acid to form salts and crystallizing out the salts."

**471,521.**—Feed water heating and purifying apparatus. Daniel W. McCallum, Fort Worth, Tex.

**471,523.**—Temperature regulator. James F. McElroy, Albany, N. Y.

*March 29, 1892.*

**471,538.**—Storage battery plate and process of making the same. William W. Donaldson and Roderick Macrae, Baltimore, Md.

**471,550.**—Process of purifying hyposulphite leaching solutions. Edward R. Holden, Denver, Colo.

Sodium bisulphite is added to the solution after the latter has served as a leach.

**471,596.**—Vapor burner. Clearmont V. Best, Canton, Ohio.

**471,602.**—Disinfecting device. Nelson M. Dyer, Toledo, Ohio.

**471,603.**—Disinfecting apparatus. Nelson M. Dyer, Toledo, Ohio.

**471,611.**—Process of producing adhesive fabrics. Bernard Hockman, Long Island City, N. Y.

**471,613.**—Adjusting device for marking machines. Charles Kaestner, Chicago, Ill.

**471,614.**—Centrifugal starch refining and separating machine. George A. Kerr, Columbus, Ind.

**471,616.** } Process and apparatus for treating refractory ores. Julius  
**471,617.** } Leede, Minneapolis, Minn.

**471,618.**—Apparatus for desulphurizing ores. Julius Leede, Minneapolis, Minn.

**471,688.**—Process of making rosaniline dyes. Benno Homolka, Höchst-on-the-Main, Ger.

The process consists in treating diamido-diphenylmethan bodies with oxidizing agents in presence of hydrochlorates of aromatic amines.

**471,659.**—Process making of diamido-diphenylmethan bases. Eduard Vongerichten, Höchst-on-the-Main, Ger.

**471,668.**—Process of manufacturing soap. William A. Grant, Houston Texas.

**471,671.**—Process of and apparatus for making gas. Julius Leede Minneapolis, Minn.

**471,672.**—Apparatus for treating refractory ores. Julius Leede, Minneapolis, Minn.

**671,684.**—Ice making machine. Daniel L. Holden, New York.

**471,688.** } Process and apparatus for separating and assorting yeast.  
**471,689.** } Gustav Sobotka, New York, N. Y.

**471,692.**—Coking oven. Herman Ekelund, Jöuköping, Sweden.

**471,707.**—Apparatus for maturing spirits or other liquor. James McKinless, Manchester, Eng.

**471,721.**—Hydrocarbon burner. Henry T. Russell, Chicago, Ill.

**471,731.**—Machine for separating gold, silver, etc. James B. Freeman, Los Angeles, Cal.

**471,757.**—Smoke consumer. Edson J. Hadlock, Big Spring, Tex.

**471,773.**—Carbureting apparatus. Lucius J. Phelps, Passaic, N. J.

**471,780.**—Method of making white lead. Elwyn Waller and Charles A. Sniffin, New York, N. Y.

**471,811.**—Filter. William M. Deutsch, Elizabeth, N. J.

**471,840.**—Filter. Luther N. Blessing, Baltimore, Md.

**471,844.**—Process of and composition for manufacturing sand bricks. Eugene H. Lewis, St. Joseph, Mich.

**471,879.**—Beverage. William M. Myers, Hannibal, Mo.

The beverage consists of  $\frac{1}{3}$  lb. of hops boiled in water and filtered, one pint of starch about the consistency of milk, which is added to this thin filtrate,  $\frac{1}{2}$  gal. of old cane molasses,  $1\frac{1}{2}$  fluid oz. ext. of sarsaparilla, and sixteen teaspoonfuls of citrate of magnesia, 1 oz. of turmeric, and sufficient water to make up a mixture of eight gallons, then adding one pint of baker's yeast and a quantity of raisins.

**471,945.**—Galvanic battery. William Burnley, North East, Pa.

**471,963.**—Process of refining oils. Thomas Drake, Huddersfield, Eng.

The hydrocarbon oils are first concentrated, and then chlorine gas is forced through the oil until its sp. gr. has increased to between .900° and 1.05°, and finally correcting the acidity of the process.

**471,995.**—Diffusion apparatus. Edward Gschwind, New Orleans, La.

J. F. G.



APRIL MEETING, Friday, April 1st, 1892.

The meeting was called to order in the Chapel of the University Building, at 8.30 P. M.; the President, Prof. G. C. Caldwell in the chair.

The minutes of the March meeting were read and accepted.

The following members were elected :

Howard V. Frost, Ph. D., Pol. Inst., Brooklyn, E. D.

Mr. C. McLaughlin, 874 Broadway, N. Y.

Mr. David M. Lichty, Ann Arbor, Mich.

Prof. W. R. Orndorff, Cornell University, Ithaca, N. Y.

Mr. J. F. Rogers, 167 Prospect st., Providence, R. I.

Julius O. Schlötterbeck, B. S., Ann Arbor, Mich.

As Associates:

Mr. Ottomar Eberbach, }  
Wm. F. Edwards, B. S., } Ann Arbor, Mich.

The following names were read for nomination to membership:

Mr. A. E. Menke, Fayetteville, Ark.

Dr. Leo Baekeland, 1964 7th ave., N. Y.

Dr. S. Burton, Waco, Texas.

Mr. John T. Enequist, Bushwick Chem. Works, Brooklyn.

Mr. Roland Molineaux, 108 Fulton st., N. Y.

From associate to regular membership:

Mr. Ottomar Eberbach, }  
Mr. Wm. F. Edwards, } Ann Arbor, Mich.

President Caldwell then read an address on :

“The more Important Events in the Progress in Agricultural Chemistry since 1870.”

A paper on

“Denitration of Pyroxylin,” by Durand Woodman, was read by the author.

The meeting was then adjourned.

DURAND WOODMAN,  
Recording Secretary.



## THE NEW YORK SECTION.

A meeting of the N. Y. members was held at the close of the regular meeting, and it was resolved that a committee of five be appointed by the Chair to consider the form of organization of the N. Y. Section and report at the May meeting.

The Chair appointed Prof. Wm. McMurtrie, Prof. A. H. Sabin, Prof. A. C. Hale, Prof. C. A. Doremus, Mr. J. F. Geisler.

## THE MORE NOTABLE EVENTS IN THE PROGRESS IN AGRICULTURAL CHEMISTRY, SINCE 1870.

In Germany, where the greater part of the recent progress in agricultural chemistry has been made, a wide field is included in this branch of chemical science. The table of contents of the *Jahresbericht ueber die Fortschritte auf dem Gebiete der Agrikulturchemie* includes these several subdivisions of the subject:—Soil, water, atmosphere, the chemical composition of the plant, the vegetation of the plant, diseases of the plant, culture and manures, methods of agricultural investigation, animal production, and accessory manufactures; this last item including dairy products, wine, beer, spirits, fermentation, disinfection, preservation of foods, cane sugar, starch, dextrose, glucose.

Within the limits of this paper I must confine myself to a narrower field.

Concerning *methods of chemical analysis*, *Kjeldahl's* publication in 1883 of his now well known method for the determination of nitrogen in organic substances, was an event of the highest importance for agricultural chemists; it may be safely said that it has been of far greater service to them, than in any other branch of the science; and since it has been made applicable also to the determination of nitrogen in nitrates as well as in organic matter, by *Scovell's* simple modification of adding zinc dust and salicylic acid or zinc sulphide, in the treatment with sulphuric acid, we do not now need any other method for our determinations of this constituent of soils, fertilizers, plant products, or animal products. At the time that this method was published, the Association of Official Agricultural Chemists of this country had come to the conclusion that the absolute method was the only one that was reliable for all their purposes. Only when we compare the cumbersome nature of this method, even with the advantage of the excellent forms of apparatus devised by them, but all depending on the collection of the nitrogen over mercury, with the simplicity and inexpensiveness of the *Kjeldahl* method, and, withal, without any

sacrifice of accuracy, and remembering that no determination has to be made so often by the agricultural chemist as that of nitrogen, the great value of this new method to him can be fully appreciated.

Of *agricultural experimentation*, a most important part consists of experiments with plants in general, or with the different species of plants of agricultural importance, under different conditions, especially as to the supply of food, the only factor over which the farmer has any essential control. Before the date of the beginning of my history, 1870, the very valuable method of *water culture*, by which plants were grown with their roots in water only, and where the conditions as to supply or exclusion of any nutrient is under almost perfect control, had been so fully developed as to leave little room for improvement since. Of *experimental culture in soils* there are three methods prominently in use, that of pot culture on carriages that can be run under shelter to protect the plants from injury by unfavorable atmospheric disturbances; second, the system of box culture in boxes as large as possible without being unmanageable, usually from two to three feet square and deep, sunk in the ground till their upper edges are even with the surface; with this method it is plain that the natural conditions of plant growth are much more like those in the field, and that the results obtained may be applied to actual field culture with less liability to error than with the first; third, actual field culture on plots of known area, with one or more unfertilized plots, or plots manured with stable manure, or both, as standards by which to measure the effect produced by the particular nutrient experimented with. Concerning this last method, the one most generally followed, there has been much discussion as to the best size of the plot, or rather the smallest size compatible with reliability of results, but without any general agreement, areas being, advocated ranging from one square meter up to a quarter of a hectare the proper size depending, as some would have it, on the number of plants growing on a given area, a smaller plot answering for barley or wheat than for potatoes or corn. While improvement has been made in this method of experimentation as the result of all this discussion, much remains yet to be done; and for want of

a better understanding of the conditions required for success, a great amount of time and means are wasted at our agricultural experiment stations. The last and best stage of improvement in box and plot culture is well represented at a new station in Dresden, Germany, established for the special purpose of experimentation on the soils of that region. A part of the station farm was stripped of its soil to the depth of three feet and in plots four by twenty-five meters; these pits were then filled each one with soil brought from a plot of the same size on some farm in the neighborhood. And for the box experiment, boxes of cement and lined with plate glass are used, one meter square and deep; the cement sides retain their shape permanently, and the glass lining will be as little corroded by the water of the soil as any material that it would be practicable to use for the purpose; these boxes are sunk in the ground as usual in box culture, in rows with excavated passage-ways between, and with provision for drawing off or supplying water from below. A system like this of box and plot culture at the station, combined as is the intention, with plot culture with the same soils *in situ* at the farms from which the samples were imported, is far ahead of anything attempted elsewhere, and is far more promising of really useful results.

Concerning the *ash ingredients of plants*, of those always present, potassium, sodium, calcium, magnesium, iron, chlorine, sulphur, phosphorus and silicon, the necessity of none but chlorine and silicon was questioned in 1870; as to the functions of any of those in the life of the plant nothing was known, except that sulphur is one of the constituents of the protein. In 1871 Nöbbe and others observed that without *potassium* no starch was formed in the chlorophyll grains, and that, unless the potassium was supplied as chloride, there was some difficulty in the transportation of the starch grains from the leaf where they are first formed, and a consequent congestion of the starch in those organs ensued. Experiments were made in 1871 apparently conclusive in their results, at least so far as concerns the plants experimented with, buckwheat and rye, that sodium cannot take the place of potassium in whatever function is performed by the latter. As to this function *Lupke*,

in 1887 showed that if this element is excluded from the food of the plant experimented with, *Phaseolus vulgaris*, all the parts are developed, even to the reproductive organs; and even if the cotyledons are removed, these containing a large part of the potassium stored up in the seed, the only indication of want of this element was a very much reduced development, as if on a scale proportional to the much diminished amount of it at command. Unlike others, he concludes that potassium is not required on account of any special function fulfilled by it; but, like nitrogen, phosphorus, sulphur and other elements it is only essential to the building up of every cell.

As to *calcium*, *Böhm* appeared to have shown that its coöperation was in some way necessary in completing the transportation of the reserve stores of carbohydrates from the cells of the seed to those of the seedling; but in 1883 *Raumer* showed that the only specialization that could be proved in respect to its function was that of taking part in the production of the building material for the cell walls; and that *magnesium*, for which no function had then been found, assisted in the transportation of the starch out of the chlorophyll grain.

In 1883 *Kreuzhage & Wolff* proved that *silica*, up to that time considered as unessential even in the cereals, where it was supposed to be necessary to the strength of the slender reed-like stalk of which it forms so large a part, is at least requisite for the fullest development of the cereal plant; that it brings about in some way a better utilization of the other nutrients, and a better production of seed, by effecting a more rapid flow of sap to the seed parts at the time of flowering, and a consequent earlier and more uniform ripening.

Concerning the necessity of *chlorine*, earlier results have been conflicting. *Aschoff* takes up the subject in 1890 and shows that it is essential at least in the case of the bean and maize; the cotyledons of the bean were removed, it having been first proved that this operation did not affect the growth in a solution containing with chlorides all the other essential nutrients, in any other way than to diminish the size of the plant; by this removal the quantity of seed chloride was considerably lessened. In all cases where

no chlorides were supplied in the food, and whether the cotyledons had been removed or not, the terminal bud soon died, and further growth ceased; the congestion of starch grains in the leaf was observed, as in earlier investigations with potassium when not supplied as chloride. Nevertheless, Aschoff concluded that no specialized function could be made out for this element, but that, like nitrogen, sulphur, phosphorus and potassium, probably a certain quantity of it is essential to the building up of every cell.

Thus, while some addition has been made to our knowledge of the necessity of certain ash ingredients, the most that has been gained as to the very interesting question of their function in the life of the plant has been in the direction of generalization rather than of specialization of function.

Not long since *boron* was found in the ash of some California wines, and the inference was naturally drawn that a borate or boracic acid had been added as a preservative, but *Crampton*, in 1890, found it in the ash of thirty-four out of thirty-six wines, of such a character as to preclude the probability that it had been added to them; later, *Hotton* found it in watermelons, and confirmed many results reported by others indicating its wide but sparing diffusion; he found it in most fruits. All this means simply that this element is uncommonly widely diffused in the soil. When boron is supplied in the food of the plant it is harmful except when present only in traces.

*Sestini* calls attention to the interesting fact that *all the elements essential to plant life* are in the first four series of Medelejeef's classification; that no element with a higher atomic weight than 56 is used by the plant; he thinks it might be reasonably inferred that only such elements as are light, having low atomic weights, would have the necessary mobility, or would possess the power of storing up so much energy as to enable them to take part in the atomic movements continually going on in the plant.

*The feeding of the plant.* The *carbon dioxide* of the atmosphere is the source of all the carbon of the plant. Prior to 1870 it was, I think, everywhere stated that the atmospheric air contained .04% of carbon dioxide. *F. Schulze* was the first to show, in 1870, as the result of a large number of determinations, that the correct

percentage is nearer .03, the average as found by him being .029. *Fittbogen*, in 1876, obtained the higher average of .033 on 347 determinations, and accounted for Schulze's lower result by his proximity to the sea ; Henneberg also obtained an average of .032.

It may be said to have been for a time the prevailing opinion among agricultural chemists that plants get their *nitrogen altogether from nitrates*. Experiments made since 1870 appear to prove that this view is untenable. In 1875 *J. Lehmann*, found on repeated trials that while buckwheat produced only a sickly growth if confined to ammonium salts instead of nitrates, maize and tobacco required ammonium salts in the first part of the season for normal growth and nitrates in the latter part ; this preference was so marked that if a sickly maize plant, making the best it could of its unsuitable nitrate food during the first half of the season, was transferred to a solution containing ammonium salts, it quickly changed its appearance and began to thrive ; or if a similar change of a thrifty ammonium salt plant to nitrate food was made during the same part of the season, the change in the other direction was no less marked ; corresponding changes in the latter half of the season gave corresponding results. *Pitsch* in 1887 showed that cereals would grow normally, producing a large amount of organic substance and protein, without a trace of nitrate in the food ; but for a certain period after germination these plants stood still, making no growth above ground ; then, as if they had in some way adapted themselves to the unwonted state of affairs, they began growing again and continued to grow vigorously. Other results have been published to the same effect, or results indicating a preference for ammonium salts ; but still the opinion is predominant that the nitrogen presented as nitrate is the more acceptable food ; it would appear to be the case that this is the ordinary nitrogen food of crops, when the ever prevailing tendency is taken into account of ammonia, in any of its compounds in the soil, to pass on into nitrates by nitrification.

Concerning the important question as to whether the *composition of the fertilizer affects the composition of the crop*, small gain has been made on the little knowledge that we had prior to 1870. Some confirmation has been given to older results showing that

increase of nitrogen in the food of the plant increases the protein in the product. It has been shown that any treatment favoring the luxuriant growth of the tobacco plant raises the production of nicotine in it ; and it may after all be possible that this is the only ground for the increased production of protein, that the plants were in a more vigorous condition. The extent of our recently acquired knowledge on this interesting and important question is very limited.

*The manner of the construction of the organic substance of the plant out of inorganic materials*, is a subject of great interest to agricultural chemists. Starch is the first plainly distinguishable organic substance produced from carbon dioxide and water, with the evolution of oxygen ; if this is really so, then oxygen should be evolved only when carbon dioxide is present. But *Mayer* showed in 1875 that the green parts of plants, in which the first organic substance is undoubtedly produced from inorganic materials, can give off oxygen in the absence of carbon dioxide, while at the same time organic acids disappear ; it is thus suggested that these acids, oxalic, tartaric, citric and malic may be stepping stones in the otherwise long leap from carbonic dioxide plus water to starch plus oxygen ; but further than this no advance has been made on this line of research. No more do we know about the formation of the albuminoids, products of still further and larger deoxidation. *Emmerling* showed in 1874 that nitric acid is set free by oxalic acid in the plant, and states that it probably becomes reduced by the same powerful agency that reduces the carbon dioxide, and that its nascent nitrogen then becomes available for the construction of the albuminoid molecule ; three years later he attempts to show that the proteids are formed in the protoplasm at the cost of amides ; and that the preliminary production of amido-acids constitutes an important part of the total assimilative processes of the plant.

*The absorptive power of soils* for some of the most important of the plant nutrients, preserving them from loss by leaching, is one of their most important and interesting properties. This property is allowed by all agricultural chemists to be due, so far as the bases are concerned, to hydrated double silicates or zeolites, to a large

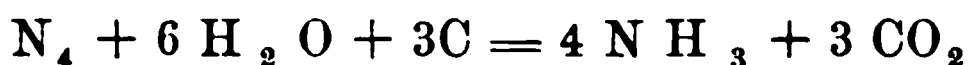


extent, these zeolites exchanging their lime or magnesia or soda for the ammonia or potash in solutions of salts of these bases coming in contact with them. In 1875 *Eichhorn* published one of the most interesting confirmations of this explanation of this remarkable property of soils; on leaving powdered chabazite, a hydrated aluminum and calcium silicate, in contact with a solution of an ammonium salt, a new chabazite was produced containing nearly seven per cent. of ammonium in the place of an equivalent amount of calcium which had passed into solution. *Knop* gave further support to this explanation of the absorptive power, by showing that in the large majority of cases it is approximately proportional to the amount of silicate present, decomposable by dilute acid; of forty-six soils examined only one possessed high absorptive power that did not also show a large per cent. of decomposable silicate or zeolite. *Armsby* in 1878, observing as others had that this exchange of bases between the silicate and the solution of potassium or ammonium salt is never complete, stated this limitation as being the consequence of a constant striving to re-form the original compounds, the condition of equilibrium being attained only when this striving balances the opposite tendency to exchange bases.

*Van Bemmelen* published two important papers on this subject, one in 1878, the other in 1888; in the first one taking the position that if the soil is freed from its basic silicates by treatment with acid, absorption of potassium from its ordinary salts except the carbonate ceases, but that it will still absorb this element from this last salt, no base being set free, while silica still takes some unexplained part. In the last paper he sums up his results and views thus; that the new compounds formed as the result of this absorption are bodies of variable molecular composition, and that they must be distinguished from chemical compounds, although they can often be converted into them; that colloidal substances form such absorptive compounds, as he calls them, with water and with bases, acids and salts, when brought into contact with their solutions; all the phenomena peculiar to this absorption can be exhibited by the behavior of these colloids to solutions of salts. The soil contains them—colloidal silicates, ferric oxide, silicic

acid and humus substances ; it is mostly the colloidal silicates that do the absorptive work in the soil. Thus this latest and most carefully developed explanation of this property of soils does not differ from the first one, except in applying a different name and different constitution to the chief agent concerned, and in assigning one common physical condition to that and the minor agents, all of which have for a long time been recognized as taking part in it.

The reasons of the universally recognized value of the products of the partial decay of the vegetable and animal remains in the soil, known under the collective name of *humus*, have received much attention ; no subject has been more discussed than the relation of the humus, and with it the clay of the soil, to the free nitrogen of the atmosphere. *Simon*, in 1875, affirmed as the result of numerous experiments that humic acid, one of the constituents of humus, absorbs free nitrogen, and in connection therewith evolves carbon dioxide, the carbon of the acid, and moisture, coöperating thus :



*Armsby*, in the same year, reaffirmed an older statement of *Deherain's*, that in the presence of a caustic alkali free nitrogen is absorbed, with the formation of some organic compound. *Truchot*, in the following year published results showing a nearly uniform relation between the proportion of nitrogen absorbed and the proportion of carbon in the soil ; and since the proportion of ulmin, one of the humus compounds, is closely related to the proportion of carbon, he infers that this is the absorbent agent of the nitrogen. In the same year *Berthelot* published his investigation, proving the absorption and fixation of free nitrogen by many organic compounds, notably some carbohydrates, as gum arabic and the cellulose of filter paper, under the influence of a feeble electric tension, and showing that such a result could be produced under the tension existing between the earth and the atmosphere.

In 1887 *Berthelot* published the results of three years' observation, indicating an absorption of free nitrogen by clay and sandy soils, poor in nitrogen and rich in potash, and that this is accomplished with the coöperation of microbes. *Tacke*, in 1889, confirmed this

statement by results of his own, adding that the presence of vegetation on the soil is not necessary, that there is no nitrification accompanying the fixation of nitrogen, and that it goes on best during the warm summer months, when vegetation is growing most actively; the last statement accords with the view that microbes, also in general flourishing most actively under such conditions, are engaged in the work. In the same year *Deherain* brings support to these views by results in field culture. The soil first had its nitrogen reduced, by cropping, from 2 grams per kilogram to about 1.5 grams; and from this time on no manure was added, while crops were removed each year; yet the soil gained in nitrogen, on two fields, at the rate of 354 and 275 kilograms respectively per hectare. *Deherain* calls attention to the necessity of the reduction of the nitrogen already present to a certain low point, before the work of the microbes begins, in accordance with *Berthelot's* statement of the requirements in the case.

This question of the absorption of free nitrogen by the soil, or by some living organisms in the soil, is naturally of very great agricultural importance, and *Berthelot's* views have been the subject of much discussion, pro and con; his special opponents have been *Th. Schloessing*, father and son, who have insisted that no such results were obtainable by them, and *Laues and Gilbert* of England, known to all agricultural chemists for the high character of all their work and for their conservatism, have doubted the reliability of *Deherain's* work, particularly on account of the difficulty of getting thoroughly satisfactory determinations of nitrogen in the soils of fields in grass. But *Kreusler*, editor of one of the best agricultural chemical journals in Germany, in a recent criticism of the dispute between *Berthelot* and the *Schloessings*, inclines to the support of the former. In view of still more recent discoveries as to the work of microbes in the soil, the contention of *Berthelot* as it stands does not seem so impossible or unreasonable as it would be, were not such coöperation of living organisms allowed by him.

In consideration of the most important relations of the soil to the crops as their chief feeder, the subject of the *analysis of soils* has received a large share of the attention of agricultural chemists from the outset, but without much satisfactory progress even in

recent years. In 1872 *Biedermann* made so much account of the determination of the absorptive power of the soil, as a means of deciding upon its relative value, as to consider other determinations of small importance; he urged especially, therefore, the determination of what he called the "aufgeschlossene silicat Basen," or practically the zeolite oxides, and also the absorptive power; he considered that one would then have done the best that he could towards obtaining chemical data for a relative valuation or "Bonitirung" of a soil. *Knop* followed in the same line. Other discussions of the subject in long papers in the German journals, by *Fesca*, *Orth* and others, appear to have resulted in little unification of opinion even as to salient points in the analysis, or those that might be made specially prominent, to the exclusion of others to be regarded at least for the present as of comparatively small importance. *Hilgard* of California has I think made more important contributions to the discussion of the question along this line than any one else; but even he would make a complete analysis of the silicate part, a determination of the phosphoric pentoxide, of the silica set free by acid digestion, of the humus by *Grandeau's* method, and of the nitrogen, besides a mechanical determination of the proportion of finest material by silt analysis; in connection with this he makes many valuable suggestions as to the interpretation of results, based on his wide experience and observation.

Both the Association of German Experiment Stations, and our own Association of Official Agricultural Chemists, have at last taken this important matter seriously in hand, and I think we may reasonably look for important scientific and practical results within the next decade.

A very large amount of valuable work has been done by *Wollny*, all of it within the last twenty years, on *soil physics*, especially the relations of the soil to heat and to water, of which I should at least make mention, besides work on the same lines in this country by *Whitney*, *King* and others; but, as it is not germane to my subject, and as there is not time for a fair digest of these researches, this mere allusion to them must suffice.

The matter of the *production of sugar* in the Northern States has received a very great amount of investigation in this country,

mostly under the direction of agricultural chemists, chiefly *Collier* first and *Wiley* afterwards, in the department of agriculture. So many of us are undoubtedly acquainted with the history of this work that has been done in our midst, that it will suffice if I present here a brief summary of the views of the latter, who is without question the best judge of the prospects of this industry, whose success may mean so much to the farmers of the North.

Concerning the manufacture of sugar from beets he says that in "certain parts of California, Oregon and Washington, all of them coast areas, certain localities in Minnesota, Iowa, Wisconsin and Michigan, and certain parts of Northern Illinois, Indiana, Ohio and New York, good beets for sugar production are yielded; but it remains yet to be demonstrated how far profitable sugar manufactures can be carried on, on this basis."

Concerning sorghum as a source of sugar for manufacture he says that the "possibility has been fully assured of developing from existing varieties a permanently improved plant, capable of cultivation for manufacturing purposes. But to develop this plant we must have a climate thoroughly adapted to it, scientifically tested seed of the most approved varieties, and much more careful attention than is given to ordinary maize." Another chemist who has given much attention to the matter, *Neale*, affirms that there is a margin of profit on cane averaging 9 per cent. of sugar; but the margin is too small to justify the hazard of any considerable amount of capital. In the last season in Delaware, all the seed sown was guaranteed to have been taken from lots of cane testing as high in some cases as 15 per cent. of sugar, while the per cent. in the cane harvested from that seed ranged from 8 to 11 per cent." The season was unfavorable; but just in this respect one of the most serious risks seems to be incurred—the sensitiveness of the plant to the season as concerns its content of sugar. As to the suitable climate referred to by Mr. Wiley, I believe it is generally allowed that reasonable assurance of it, such as would attract capital, is to be found only in certain limited areas in the Northern States.

An enormous amount of work has been done in Germany, and much, also, in this country, on the *relation of the crops pro-*

*duced by the farmer to the feeding of his stock.* Within the limits of my history the importance of the occurrence of the different forms of nitrogenous matter in foddering materials has been fully shown, and the nitrogenous constituents have received by far the largest share of the attention of agricultural chemists. That part of the nitrogenous substance of agricultural crops used for stock feeding, which is not genuine albuminoids, is made up chiefly of amide substances. Presuming that they cannot have the same nutritive value as the genuine proteids, their quantitative estimation is of great importance. *Kern* and *Schulze* attempted their direct estimation in 1879, but failed of success, and the latter proposed to remove the real protein, which I will designate by this name, protein, and then determine the nitrogen in what is left. *Kellner* claimed sufficient accuracy for his process of extracting the non-proteid substance with alcohol, acidified with acetic acid, and determination of the nitrogen in the residue. In 1880 *Armsby* claimed that all the non-protein in hay could be extracted simply by boiling water; but he does not affirm that this method can be applied to all fodders. In the same year, *E. Schulze* and *Barbieri* proposed to distinguish three classes of nitrogen compounds in the fodder: (1) the protein, precipitable by cupric hydroxide, (2) the pepton-like substances, alkaloids, ammonium salts, etc., precipitated by phospho-tungstic acids, and finally (3) what is not precipitated by either of these reagents, or the amide substances. But no proposal has met with such general acceptance as that of *Stutzer*, in the same year, of precipitating the protein by cupric hydroxide, determination of the nitrogen in this precipitate, and, by subtraction of this from the total nitrogen, getting the non-proteid nitrogen. This method is everywhere used now, and essentially as he first described it. In the examination of a large number of fodders, the amide nitrogen has been found to range from nothing in a few cases up to sixty per cent. of the total nitrogen; even in wheat and other grains, in which, at first, the nitrogenous substance was supposed to be pretty much all protein, there may be from thirteen to forty-six per cent.

Before leaving this part of the subject mention should be made of the valuable work done by *Osborne*, of the Connecticut Ex-

periment Station, on the *proteids of the oat kernel*, and a new proteid extracted at 65° C. by ten per cent. solution of sodium chloride, and separating from the solution on cooling, in spheroids; and the work of *Chittenden* and *Osborne* on the proteids of the maize kernel, in which three globulins, one or more albumins, and zein, a new proteid, soluble in alcohol, were isolated; the zein contains an unusually high per cent. of carbon.

The question of the *value of the amide substances of fodder* is of the highest agricultural significance, because of the supreme importance of the protein itself for purposes in the animal economy that no non-nitrogenous constituent can serve. This question has therefore received very careful attention on the part of agricultural chemists. Asparagin is taken as a type of at least a large part of these compounds in fodders.

In 1887 *Weiske* experimented with it on hens, guinea pigs and sheep, and concluded from the results obtained that it saves protein from waste or loss, or, in other words, in some way leads to the conversion of a larger proportion of the digested protein of the fodder into animal substance than would take place without its presence. Similar results were obtained in other experiments, with goats, sheep and geese. Hence these amide substances may become particularly useful in connection with the feeding of a ration poor in protein. In the case of milch cows *Weiske* found that half of the protein of the ration could be replaced by asparagin, without loss in body weight, or in the flow of milk; if carbohydrates were substituted for the asparagin, the animal lost weight and the milk yield was diminished. This result with the asparagin is remarkable, because no one supposes that it can be converted into proteids in the animal. In the case of carnivorous or omnivorous animals, asparagin produces no such effect. But not all amide substances work in the same way; in the cooking of fodder the protein is converted partly into peptones and partly into amide bodies, some of which may cause greater waste of digested protein, instead of saving it: such bodies are tyrosin and leucin. *Weiske*, in 1890, published this result, and gave, also, an interesting illustration of the effect of differences in the chemical structure of some of these



bodies. Amido-succinic acid, and amido-succinamic acid, work in opposite directions on the utilization of digested protein: one has the amide group in the radical, and the other in the carboxyl group. In 1890 *Gabriel* made public the results of investigations on the steaming of lupine, the temperature being kept so low as to avoid the production of injurious amide bodies; he had found that this production was a matter of temperature; in these results the value of the useful amide bodies was strikingly shown. On a daily ration of raw lupine containing 12.44 grams. of digestible protein and 0.7 grams. of non-proteid nitrogen, 2.39 grams. of nitrogen were fixed as animal substance in the body; on a daily ration of steamed lupine, the temperature being kept below 135° C. in the cooking, containing 8.25 grams. of digestible protein and 1.88 grams. of non-albuminoid nitrogen, 2.75 grams. of nitrogen were fixed in the body. These results indicate that a mixture of protein with amide bodies may have a higher nutritive value than protein alone.

In the process of preserving fodder in closely packed masses in pits or wooden inclosures, known as ensilage of fodder, it is proved beyond doubt that, in the fermentation taking place, a notable proportion of the protein is converted into amide substances; and yet it is no less indisputable that this fermented fodder will cause at least as good a flow of good milk as will an equal weight of dry substance in the same kind of fodder, cured in the usual manner. This experience, hundreds of times repeated, as it has been, serves to confirm the conclusions of *Weiske* and others as to the usefulness of these bodies.

And yet *König*, a high authority on this subject of fodders and feeding, affirms in one of the most recent numbers of a German journal that the latest investigations on this subject have given results which lead him to believe that the question must still be considered as an open one, and that we may yet be forced to conclude that amide substances do not act in the manner above indicated.

In 1889 a paper was published by *W. E. Stone* on a new class of carbohydrates called *pentagluco*ses derived from plants, now more often called pentoses, the number of atoms of carbon in the sim-



plest formula being five, instead of six as in all other carbohydrates. They are derived from a peculiar class of gum-like bodies, occurring in common fodder plants in proportions ranging from 1 to 12 per cent. They were found also in large quantities in the manure of animals fed on two quite distinct rations. Since, as in digestion experiments, the digestibility of any constituent of the fodder, as the carbohydrates, always reckoned together in the analysis under the name of the nitrogen-free extract, is taken as the difference between the nitrogen-free extract in the ration consumed and the nitrogen-free extract in the solid excrements, and since these pentoses, or their corresponding gums, would be included in the nitrogen-free extract as usually determined, their existence stands in an important relation to these determinations of the digestibility of fodders. Further experiments with them have shown that they are to a marked degree less digestible than starch or sugar; consequently they accumulate in the solid excrements, giving to the nitrogen-free extract of this matter a different composition from that of the ration fed, while we have been in the habit of assuming that the composition was essentially the same. Thus all the laborious digestion work will need to be done over again to make it accurate.

These pentose-yielding gums are found to be widely diffused in nature, in condensed molecules, as is the case with the hexoses, as the regular carbohydrates may be called; wheat straw or ears is one of the best substances from which to prepare them, by simply heating with acid, producing hydrolysis. When heated in certain proportions with hydrochloric acid furfural is produced, instead of laevulinic acid, as with the hexoses; and this production of furfural is made use of in their quantitative estimation. Arabinose and xylose are the two pentoses thus far isolated. Much of our present knowledge of these bodies is due to *Tollens*, with *Stone*.

One of the proximate constituents always determined in the analysis of fodder is the so-called *crude fibre*; a part of this is digestible, as of the protein, fat, and nitrogen-free extract; this digested part was pronounced by *Schulze* and *Maercker* in 1875 to be identical with pure cellulose; and it was for a long time regarded as equally valuable for fuel, in the animal economy, with starch and

sugar. But in 1884 *Tappeiner* published researches indicating that all this crude fibre of the ration that did not appear in the solid excrements, and was therefore supposed to be digested, was never digested at all, or not taken into the circulation; but that it was simply fermented in the intestines, with the production of intestinal gases; this conclusion was accepted by *Weiske* and others eminent in this line of work; it must have been accepted unwillingly since it made of no account a large part of their own previous investigations.

In 1889 *F. Lehmann* made this matter the subject of a long investigation; and he appears to prove conclusively that *Tappeiner* was wrong; his results showed that the protein-saving effect of sugar is to that of digested crude fibre, or cellulose, as 100 to 74.7, and that the protein-saving effect of starch is to that of digested cellulose as 100 to 61. This constituent of the fodder seems, therefore, to be fully relegated to its former place.

In 1880 appeared *Stutzer's* first statement of his method of *determining the digestibility of the protein of the fodder by treatment of it with artificial gastric juice*, instead of passing the fodder through the animal and getting digested protein by protein in the fodder eaten minus protein in solid excrements; the method was improved, later, by following the treatment with gastric juice by that with pancreatic juice; its greater simplicity commended it at once; and it avoids the error in all results by the natural method, due to the fact that a part of the nitrogenous matter in the intestines belongs to secretions which have passed in from some organs of the body, and is not therefore really undigested crude protein of the fodder. The natural inference that since these substances were produced in the animal out of digested matters, they would be extracted from the solid excrements by treatment with digestive agents, as pepsin, was tested; and it was found that when digested protein by the natural method was considered to be crude protein of the fodder, minus crude protein of the dung calculated from the nitrogen left *after this extraction by pepsin*, the results agreed more closely with those obtained by the artificial method—that in fact the agreement, in general reasonably fair in most cases without this correction, was with the correction very good. If equally

satisfactory methods could be developed for the determination of the digestibility of the other proximate constituents of the fodder, it is not at all unlikely that the cumbersome and tedious natural method would be relinquished. But all attempts in this direction having failed of success, the fodder whose digestibility is to be tested must still be passed through the animal; and it makes less work to include the protein in this set of operations than to determine it by the artificial method. Some chemists, as *Pfeiffer* in 1890, express themselves as not yet sure of the reliability of the artificial method, even though it would seem to be unquestionable that a laboratory experiment must be less exposed to error than a barn experiment with a living animal, the materials and reagents used in both cases being practically the same, and the conditions the same as to temperature, duration of treatment and so on. And the conclusion would seem to be sound, that, if there is, disagreement between the results by the two methods, the natural method should be regarded as the faulty one.

A very large number of analyses of fodders and feeding stuffs has been made within the past twenty years, in Europe and in this country, in the laboratories of the Agricultural Experiment Stations. Furthermore, many of the German Experiment Stations and some of our own, notably those of Maine, New York (Geneva), Pennsylvania and Wisconsin, are fitted out with the necessary appliances for digestion work by the natural method; they are continually adding to our knowledge of the subject and working on new practical problems that are constantly presenting themselves. In 1874 *Dietrich* and *Koenig* issued a work of 84 pages on the Composition and Digestibility of Fodders, giving in the form of Tables the results of the work that had been done up to that time. In 1891 the second edition of this work was published in two volumes of 1,500 pages in all, and its compilation was the result of ten years' work. No more striking presentment could be given of the amount of work done on these lines of investigation, but it would be useless to attempt to summarize the results of this work, in the brief space of a few minutes; and none of them are notably prominent, although all are valuable as a part of the whole.

In respect to the composition of milk some new and interesting

results have been obtained within these twenty years. The question of *the existence of an enveloping membrane of albuminous matter*, inclosing the fat of the globule, has been conclusively settled by the investigations of *Soxhlet* in 1874, and especially of *Babcock* in 1885. The latter prepared an emulsion of oil by trituration with sugar and water, which was then diluted with water, as it could be to a large extent without destroying the emulsion. Such a diluted emulsion was identical with milk in all its properties except that there was more variation in the size of the fat globules; the fat gradually rose to the surface in the same manner, the cream so obtained could be churned to a substance resembling butter in consistency; there was the same difficulty in extracting the fat from the emulsion, by shaking up with ether, that there is with milk, which was one of the strongest arguments used in support of the existence of a membranous sack inclosing the fat. Another no less conclusive proof of the non-existence of the envelope was found in the increase in the number of the fat globules that can be brought about by simply stirring milk vigorously with an egg beater, while kept at a temperature of about 40° C. or above the melting point of the fats; the number being 159 in 0.0001 millimeter cube of a sample of fresh milk, it was raised to 174 by the first stirring, then by another stirring to 231 and by a third to 283; in another experiment the number of globules above a certain size was found to be greater before stirring than after, demonstrating by observation what must necessarily be the case if the globules are divided by this operation, that the number of smaller globules is relatively increased.

Two new *normal constituents of milk* have been discovered. In 1888 *Babcock* announced the discovery of a fibrin in milk, to which he gave the name of lacto-fibrin. Soon after milk is drawn the fat globules, before uniformly distributed, are more or less grouped together, which is supposed by *Babcock* to be due to their entanglement in the clots of coagulated fibrin; solution of potassium hydroxide prevents coagulation of the fibrin; and if the milk is drawn directly into such a solution, no grouping of the fat globules is observed. Fibrin, unlike other proteids, decomposes hydrogen peroxide; milk possesses this property, because of its fibrin, and a

method of determining the relative amount of fibrin in different samples of milk was based on this reaction.

In 1888 *Haeckel* announced the discovery of citric acid as another normal constituent of milk. Soxhlet had concluded that there must be an organic acid in milk, whose neutral lime salt is soluble, because the quantity of lime in solution is incompatible with the quantity of dissolved phosphorus pentoxide. There is no lactate in fresh milk; later, citric acid was found and unquestionably identified.

Experiments made in 1891 showed that it does not come from citric acid in the fodder, for its quantity is not increased if this acid is added to the ration, nor is it produced by fermentation in the large intestines; it appears to be one of the normal products of the special metamorphosis of which the milk as a whole is the product. The quantity of it varies from 1.7 to 2 grams. per liter, while it was calculated that there should be 2 grams. to take up all the lime that could not otherwise be satisfactorily disposed of.

No question has been more discussed or investigated by agricultural chemists than that of the *nitrogen supply of plants*, and some of the finest researches in chemical science have been devoted to this subject. It has been already referred to in this paper in the account of some studies on the relation of the soil to the free nitrogen of the atmosphere; and mention was made of the possible coöperation of a third agency in the accomplishment of some of the results there claimed to have been obtained, namely microbes. No student of that side of chemistry which relates more particularly to the conditions of our own existence and comfort needs to be told that, within less than the limits of the period of my history, the existence has been established of such intimate and important relations between higher vegetable life and animal life on the one hand, and microbial life on the other, that the chemist who would be an investigator in vegetable and animal chemistry must either be a bacteriologist himself, or else must often call in the aid of the bacteriologist, before he can solve some of the most important questions that confront him.

Since some of the most interesting contributions toward the solution of vitally important agricultural chemical questions have

been made through this coöperative study of the chemist and the bacteriologist, and since these researches are published in agricultural chemical journals as if properly belonging there, I certainly shall not be accused of going outside of proper bounds, if I devote the closing part of my paper to an account of some of the most striking results that the bacteriological chemist or the chemical bacteriologist has given us.

*The process of nitrification* as a natural process, or the natural tendency of nitrogen in certain widely diffused compounds to pass on into the form of nitrates, has long been known. The discovery of ozone as a constituent of the atmosphere, with its great oxidizing power at common temperatures, led naturally to the belief that nitrification even of free nitrogen took place through its aid.

*Schönbein* affirmed that even in connection with the evaporation of water, nitrites and nitrates are formed, as well as in connection with the combustion of organic and inorganic substances—ozone being first produced in both cases. Schönbein's fundamental experiment was simply this: to collect the vapor from water dropping slowly into a hot crucible, on the walls of a large beaker; this water usually gave after acidification a blue color to iodized starch paper. *Baumann*, in 1888, went over all of Schönbein's experiments, and, with the aid of the much more delicate tests for nitrous and nitric acid that we have now than any that were known in Schönbein's day, proved that these acids are always formed in connection with any combustion, but especially the burning of illuminating gas, and that this was the source of the nitrogen acids in Schönbein's fundamental experiment above described. Baumann also proved that calcium carbonate and all oxides, basic bodies or hydroxides prepared and dried in the ordinary manner, either by exposure to air or in chambers heated by gas, contain these acids, taken from the air while being dried, if not in some previous stage of their preparation. These experiments by Baumann, and others along the same line, appear to have deprived the contention of all support, that manganic hydroxide in conjunction with alkaline carbonates possess the property of producing nitric acid from water and free nitrogen, or that free nitrogen or the nitrogen of

ammonia is oxidized by the oxygen of the air, by the simple co-operation of alkaline carbonates or calcium carbonate.

The production of nitrite and nitrate from the nitrogen of dead vegetable or animal substances, or of ammonium salts, in porous soils, by simple exposure to warm, moist air, was supposed, prior to 1877, to be due to simple oxidation. In that year *Schloessing* and *Muntz* proved that the coöperation of microbes was required, since this nitrification would not go on in sterilized materials, and is altogether stopped by vapors, as of chloroform, poisonous to microbes. As soon as the discovery was made, it was seen that all the conditions of nitrification, as to temperature, moisture, free access of oxygen, are such as are required for the active life of ærobic bacteria. The only mycologist of any note who at first refused to accept this explanation of nitrification was *Frank*, of Berlin, who maintained that nitrification could take place in a porous soil as in platinum sponge. In answer to him *Plath*, working under Landolt, in 1887, went over the whole ground with great care testing all the usual constituents of soils separately, and proved that in none of them would nitrification of nitrogen in any form take place if they were previously sterilized.

Much importance was attached by Frank to the failure of all attempts to isolate the microbe by pure culture. But *Winogradsky*, in Zurich, and the *Franklands* and *Warrington* in England, found, after much patient investigation, and announced at about the same time, in 1890, that the nitrifying bacterium would not grow in Koch's gelatine plate. Winogradsky, by successive cultures in a solution containing no organic matter whatever, but only ammonium sulphate and potassium phosphate, with a small quantity of basic magnesium carbonate, after many inoculations of solution after solution, succeeded in obtaining the nitrifying organism in a zoogloea, or jelly-like mass, coating the deposit of magnesium carbonate in the bottom of the vessel; here it was, however, invariably accompanied by another microbe, which, as was found, could grow slowly in the gelatine plate; to separate the two, therefore, all that was necessary was to distribute the zoogloea in a gelatine plate, then after several days carefully cut out those parts of the plate that were *not* occupied by any colonies, and with these



inoculate new solutions. The single species of bacterium thus isolated was proved to possess the power of nitrifying ammonia, and to it the name *nitromonas* was given.

The very interesting features of the life of *nitromonas* are these : that like other plants it gets its carbon from carbon dioxide, obtained from the carbonate around which it grows, and accumulated in these cultures in the form of a jelly-like substance ; but unlike other plants which get their carbon from carbon dioxide, this one works without light and without chlorophyll. Moreover, while other microbes decompose organic matter, and get their carbon from that source, this microbe produces organic matter out of materials entirely inorganic. The most interesting feature remains yet to be mentioned. The function of the vegetable kingdom in relation to the animal is the storage of energy for the use of the animal ; the ordinary plant, producing organic substance with the aid of chlorophyll and the sun, gets its energy from the sun ; the parasite, or the microbe that decomposes the organic matter on which it lives, gets its energy from the organic matter so decomposed ; where does *nitromonas* get its energy ? The answer is simple : from the oxidation or combustion of the nitrogen of ammonia which accompanies its growth and multiplication, and for which the oxygen of the air is used—not simply the oxygen of the carbon dioxide decomposed, for that would be no gain.

In the same year the *Franklands* published their results in a paper read before the Royal Society of England ; they also failed entirely with gelatine plate culture, but did succeed with simple sterilized distilled water culture ; and in their cultures also, another microbe accompanied the nitrifier ; or, rather, starting with another portion of the same solution, and proceeding in precisely the same manner, the final product was a microbe which did not nitrify, and did grow in the gelatine plate.

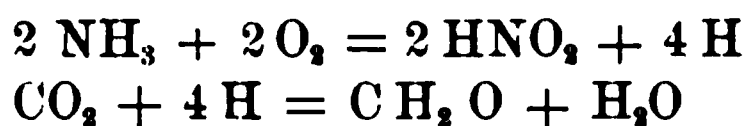
In 1891, *Warrington*, of the Rothamstead laboratory, published the final results of his work on this subject, which had been going on since 1880. Like the other investigators he failed in all attempts to cultivate the microbe in organic media, but succeeded in solutions containing ammonium chloride, calcium carbonate and a phosphate ; he isolated an organism that would oxidize ni-



trite to nitrate, but would not oxidize the nitrogen of ammonia, and another that would oxidize only the nitrogen of ammonia; both lived only in solutions of inorganic matter; the nitrite microbe was isolated from the nitrate microbe by successive cultures in solutions containing the nitrogen in the form of ammonium carbonate, while the nitrate microbe was isolated from the other by successive cultures in solutions containing nitrogen as nitrite, and sodium bicarbonate to supply the carbon.

Winogradsky also announced, in 1891, that he had isolated the nitrate organism, after much difficulty, and that his *nitromonas* oxidized only nitrogen of ammonia to nitrite.

As to the mode of production of organic substance by *nitromonas*, it was at first suggested that, as in plants containing chlorophyll, carbohydrates were at once produced; but *Oscar Loew* regards it as more probable that the action of the nascent hydrogen of the ammonia should come into play, forming formaldehyde with carbon dioxide.



This formaldehyde by simple molecular condensation may yield carbohydrates, or it may also serve at once in the synthesis of proteids. This is purely theoretical, but nevertheless interesting in this connection.

The next interesting step in this matter of nature's methods of providing nitrogenous food for the plant is the announcement by *Müntz* in 1890, of the discovery of microbial action in the production of ammonia from the nitrogen of organic matter; if the soil in which production of ammonia is going on is sterilized by heating it to 120° C., the production is arrested, and is started again when a little unsterilized soil is added in which ammonia production is going on.

Before leaving *nitromonas* and his companions who are engaged in this most important work of converting the nitrogen of soils and manures into the most valuable form of nitrogen food, I must notice one other operation of no less importance in which they take part indirectly. Since *nitromonas* can produce organic

matter wherever there is ammonium carbonates together with phosphate and potash, and since the first mentioned salt is always present in the atmosphere and the others are widely even if sparingly diffused in the rocks, we need not be surprised by the discovery announced by *Müntz*, in 1890, of these organisms engaged in the production of organic substance on bare rocks and mountain peaks; in the Alps and the Pyrenees he found the disintegrated particles of those rocks always covered with organic matter, and the nitrifying microbes always present; he has even found them "alive and ready to resume activity after a sleep of ages under the enduring ice of glaciers;" on the walls of the smallest crevices of the rock; on fragments of rock in or on the soil; and he affirms that by this production of the powerful nitric acid within these masses and fragments of rock, they become indirect agents in the conversion of rock into soil. As a striking illustration of this he cites the case of the Faulhorn in Switzerland, literally translated Rotten Peak. This rock consists of calcareous schist, friable and disintegrating; and he found it to be invaded through its whole mass by the nitric ferment.

So far in the consideration of this microbial work, we have dealt only with nitrogen already in combination; but the work of microbes in the farmer's behalf by no means stops there; in a mysterious and as yet unexplained way they seize hold of and put at his service the free nitrogen of the air. The classical researches of *Boussingault*, and of *Lawes*, *Gilbert* and *Pugh* proved conclusively that, at any rate, cereal plants, and in all probability all other agricultural plants, are entirely unable to assimilate the free nitrogen of the atmosphere; but nevertheless it was impossible to explain away the universal opinion firmly held by farmers, and supported also by numerous experiments, that leguminous plants, clover, lucerne, and the like, were not only comparatively indifferent to the supply of nitrogenous food in the soil, but would, while demanding much nitrogen for their own growth, leave the soil even in a better condition for crops which must have a liberal supply of assimilable nitrogen in the soil.

In 1858 *Lachman* described, in a Vienna scientific journal of narrow circulation, the existence of small swellings or tubercles

on the roots of some leguminous plants, recognized the bacterial nature of the contents of these swellings, and said it might be supposed that they stand in some relation to the claim of the farmer that these plants gain nitrogen; but that probably they only help the plant to make better use of the ammonia and nitrate in the soil. There the matter rested for nearly twenty years, when *Wilfarth* and *Hellriegel* published the remarkable results of a series of experiments with a small number of leguminous and non-leguminous plants. The seeds of these plants were planted in sand containing all required food except nitrogen compounds: the growth of the seedlings soon stopped in all cases: if, however, there was added to the sand of each pot about a cubic centimeter of a cold aqueous extract of arable soil, containing at the most not over 0.7 mgm. of nitrogen, every one of the leguminous plants began to grow again after a short time, and continued growing luxuriantly; but no change took place in the condition of the non-leguminous plants. These experiments were repeated with 178 pots, and in all cases with the same results; as a variation in the method some of the sand was put in the bottom of a carboy, a pea, buckwheat and oat seed were planted, the soil extract was added, a supply of carbon dioxide was provided, and the carboy was sealed up: only the pea grew beyond the first, seedling, stage and the whole plant contained 137 mgms. of nitrogen, for less than 0.7 mgms. added. Here are the yields of nitrogen in four pots of lupine in the first mentioned set of experiments, without soil extract added: 14.6, 13, 13.6, 13.3 milligrams; with soil extract added, 1099, 1194, 1337, 1156 milligrams. The sand in each pot weighed four kilograms; the soil of an acre a foot deep weighs about 3,500,000 lbs.; allowing that the sand in each pot weighed 10 lbs. instead of about 8.8 lbs., and supposing that each lupine plant would have done at least as well in the field with 10 lbs. of surface soil plus indefinite depth below the level of one foot, which is not unreasonable, since in these experiments the roots were confined altogether to the few inches in depth of the pot, this gain in nitrogen would represent over 900 lbs. per acre; an extremely liberal dressing of sodium nitrate, 400 lbs. per acre, would not contain over 65 lbs. of nitrogen.

Hellriegel and Wilfarth suggest that the tubercles on the roots of the legumes had something to do with this assimilation of free nitrogen of the air, for such it was ; the nitrogen could have come from no other source. They do not mention Lachmann's work, and must have been ignorant of it; they are investigators of high rank, and would have given due credit to him, had they known of the existence of his paper, which was brought to light only two or three months ago.

Of course such an intensely interesting discovery was at once taken up by other agricultural chemists and by bacteriologists; the results above described were confirmed and endorsed by such investigators as Lawes, Gilbert and Warrington, of England; Schloessing's son and Laurent, Berthelot, Deherain, in France; Nobbe and Beyerinck, in Germany; Atwater and Woods in this country; and at the last meeting of the chemists of the German Experiment Stations the work of Hellriegel and Wilfarth was endorsed by a special and unanimous vote.

*Nobbe* observed that the organisms that do this work are almost universally diffused in arable soils ; that the extracts of soil on which leguminous trees or shrubs are growing are very powerful as inoculating material; that when inoculation is made with a pure culture product it is most efficient on that species of plant which was occupying the soil from which the culture was started.

*Schloessing* (son) and *Laurent* proved not only the gain in combined nitrogen made by the plant, but also the loss in free nitrogen of the atmosphere, in a confined space in which the plant grew.

As to the explanation of the phenomenon different views are held by different bacteriologists. All are agreed that there is here a case of symbiosis—a partnership or association between two plants for their mutual benefit ; the fungus is benefited, because it finds in the roots of these plants conditions favorable or necessary for its growth; the tubercles produced on the roots of leguminous plants, and apparently only after infection with the fungus, are its home in which it carries on at least a part of its development; the growth of these tubercles does not harm the host plant; free nitrogen is taken up and worked into organic matter; and eventually the

fungus dies and this nitrogenous organic matter is used by the host plant for its own growth. Whether the organism is a bacterium, or more nearly allied to the yeast fungi in its mode of growth, is the special point in regard to which the results of researches differ.

It may seem that since Boussingault, and Lawes, Gilbert and Pugh, included legumes in the plants which they experimented with, these latest results are incompatible with theirs. But it is not at all so. They used sterilized soils; that is, the soils had been ignited to expel all nitrogen compounds, but they did not call it sterilizing in those days; and their plants were as a general thing carefully kept from contact with any other atmospheric air than such as had been carefully washed by passage through strong sulphuric acid, to free it from ammonia; and there was no possibility of that inoculation of soil or plant roots with extracts of arable soil, which was in nearly all cases essential to carry the growth of the leguminous plants, in their latest experiments, beyond the hunger period.

In its relations to the operations of the dairy, the study of bacteriology has only just begun; but already, in so far as the work of bacteria has been looked for where it might be expected, it has been found. It has for a long time been known that milk is a most efficient means of transporting infectious diseases; as we now know, this is because its chemical composition adapts it so well for the nourishment, while in transitu, of the microbes which are the actual carriers of the diseases. But their work is not all of this baneful character. Two illustrations must suffice: cream must undergo a certain change, called its ripening, before butter of the best flavor can be produced from it. The microbe that causes this change has been, at least to a large extent, separated from many others in the milk, and it is claimed that the pure culture of it can be practised on a large scale in the dairy; the directions for this operation were first given by *Weigmann*, in 1891, with seed to be obtained from some bacteriological institute, and the use of this pure culture product is specially recommended at certain seasons of the year when it is particularly difficult to make good butter.

Again, in the ripening of cheese, we should naturally look for the action of microbes. Several investigators have taken this matter up, but by far the most careful research was made by *Adametz*, and published in 1889. He identified twenty-eight species of bacteria in ripening cheese, and a very large number, 850,000, in a gram of a hard cheese (*Emmenthal*), and 5,600,000 in a gram of one of the soft cheeses. Two distinct kinds of change take place in the ripening of the cheese: the conversion of some of the insoluble casein of the fresh curd into a soluble and more digestible form; and, second, the development of the flavor, by which one kind of cheese is distinguishable from another. If the curd is sterilized at the time when it is ready to be put away in the ripening room, and is there protected from infection, neither of these changes takes place; the dependence on microbial coöperation is thus established. Adametz was not able to identify any one species of bacterium as that one which exclusively produced the flavor of the one kind of cheese or of the other. The most he could establish was that the solubilizing of the curd was effected by one or more kinds, and the production of the flavor by one or more other kinds. A great amount of work remains to be done in this special field alone.

## NOTE ON DENITRATION OF PYROXYLIN.

BY DURAND WOODMAN, PH. D.

An interesting reaction, but one which seems to be considered of little practical importance is that described in the brief references herewith given.

“Some nitrogenous substances, as albumen and pyroxylin, are reduced to a less complex form by certain deoxidizing agents, as ammonium sulphide, ferrous chloride, sulphurous acid, and others, the change consisting in the loss of  $\text{NO}_2$ .”—(*Gmelin, Handbook, Vol. XVIII.*)

“A solution of potassium sulphhydrate, especially if mixed with alcohol, reproduces the original cotton (from pyroxylin) with formation of  $\text{KNO}_3$  and a little ammonia.”—(*Watts' Dict. IV., 778.*)

“By the action of reducing agents, such as ferrous chloride or acetate, or potassium sulphhydrate, the cellulosic nitrates are converted into cellulose even by digestion at the ordinary temperature. By boiling with a solution of stannous oxide in  $\text{KHO}$ , the nitro-celluloses are dissolved, with conversion into cellulose, which is precipitated in flocks on neutralizing the liquid.”—(*Allen Com. Org. Anal. I., 327.*)

Samples of ordinary photographic collodion film and thin sheets of celluloid free from coloring or mineral matter, were reduced in a bath of ammonium sulphide.

It is necessary to dilute the reducing agent somewhat and keep the bath cooled by immersion in water during the early stages, or the reduction takes place with such rapidity that a very considerable rise of temperature results, accompanied by a deposit, in and on the material, of finely divided sulphur which can be removed only by solvents. A too rapid reduction and consequent rise of temperature is also not without seriously injurious effect on the tenacity of the resulting cellulose film.

After washing for several hours in running water, the material is dried and will now burn quietly like wood or paper. Analysis

of the material so obtained gave the following result, a parallel analysis of ash-free filter paper being made at the same time for comparison.

	Denitrated Pyroxylin.			Cellulose from Ash-free Paper.
C	41.86	42.03	41.76	44.00
H	6.14	6.18	6.07	6.32
O	50.68	50.47	50.85	49.68
S	.60	—	—	
Ash	.72	—	—	
	100.00			100.00

The sheets of cellulose obtained by the denitrating process are very much reduced in area and increased somewhat in thickness, as compared with the original sheet of pyroxylin.

Measurements were made of a number of sheets before and after treatment to obtain figures expressing the approximate amount of shrinkage.

The average measures were :

	Length.	Breadth.	Thickness.
Before treatment	15.0 ins.	10.0 ins.	.0057 in.
After treatment	11.76 ins.	7.5 ins.	.007 in.

The percentage decrease of area and volume (approx.) were as follows :

	Area Decrease.	Volume Decrease.
No. 1	35%	21%
No. 5	40%	37%
No. 7	47%	29%
No. 8	46%	22%
No. 9	48%	34%
No. 10	45%	28%
No. 11	45%	33%

The decrease in volume can only be considered a rough approximation.

The material is slightly hygroscopic, quite strong, elastic, becoming somewhat brittle when very dry, and is translucent or



transparent according to the purity of materials used in manufacture and thickness of the sheet. *Sp. Gr.*, 1.545.

One of its most interesting practical applications has been the preparation from it, of incandescent electric lamp filaments, its homogeneity of structure, when carefully prepared, rendering it a promising substance for this purpose. As the reducing action will not penetrate beyond a few thousandths of an inch, the process can be successfully operated only on thin sheets of pyroxylin.





## EXAMINATION OF AN UNUSUAL FORM OF SPRING WATER.

BY JAMES H. STEBBINS, JR.

A short time since a sample of spring water was handed to me for examination, and as it possessed some remarkable properties, I have thought that a brief description of the results obtained would be of some interest.

The spring is located in New Jersey (the exact locality being at present unknown to me) and the water has for a number of years been known as the "sweet spring water." The water is clear, without taste, is neutral to test paper, but has a slight smell when the bottle is uncorked. So far the water does not differ materially from any other good spring water. It however possesses one peculiarity, which I have never met with before, namely, quite a pronounced viscosity, which is even quite suggestive of the viscosity of glycerine.

This unusual phenomenon immediately suggested to me the presence of gelatinized silica; but a few tests soon showed that the viscosity is not due to the presence of silica. The only plausible explanation is that the viscosity is due to some organic matter, in the shape of either algae, bacteria or other form of growth. This hypothesis was found to be the correct one, as was at once seen by determining the total solids, which were found to be 8.2 grains per gallon. On ignition, the solids turned black at first and then burned to a white ash, leaving 3.2 grains per gallon of inorganic matter. We thus see that the water contains:

Inorganic matter.....	3.2 grains per gall.
Organic matter.....	5.0 " " "

Having now determined that the larger part of the solids is composed of organic matter, the next question to be determined was the nature of this organic matter. For this purpose, the mi-

microscope was brought into play, with very satisfactory results. If a drop of the water be placed upon a slide, and then examined under a microscope, nothing of any importance will be revealed. But, if evaporated to dryness, and then examined, it will be found that the slide is literally covered with little rod-shaped bodies; very much resembling some forms of bacilli. Some of these bodies were in the form of short chains, others were scattered in every direction, and some were bent up in the shape of a letter S. I have made a photo-micrograph of these, magnified to 400 diameters (see cut). Whether this organism is vegetable or animal I am at present unable to say, but it is evident that the remarkable viscosity of the water is due to its presence.

It is also probable that this organism has the same index of refraction as the water itself and is therefore invisible. The water, on standing, seems gradually to undergo decomposition, as indicated by the smell. On trying the action of precipitants, it was found that alum failed to precipitate the organic matter; but an alcoholic solution of lead acetate completely precipitates it, in the shape of a white, stringy coagulum. The water is free from nitrates and chlorine, but contains traces of sulphates and nitrates. The amount of inorganic matter being so small, it was not deemed necessary to make an analysis of the same. As the nature of the organisms found is unknown to me, I would be obliged for any information which may throw more light upon the subject. I have been informed that the water has been drunk for years by the natives of the locality, without producing any serious results.

## Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

Issued April 5, 1892.

**472,026.**—Galvanometer. Sigmund Bergmann and George A. Scott, New York, N. Y.

**472,033.**—Process of enameling sheet metal articles. Hubert Claus, Thale, Germany.

**472,076.**—Regenerative metallurgical furnace. Henry C. Rew, Chicago, Ill.

**472,077.**—Apparatus for the manufacture of gas. Henry C. Rew, Chicago, Ill.

**472,085.**—Method of and appliance for the collection and utilization of carbonic acid gas and other products given off during the process of fermentation. Chas. R. C. Tichborne, Alfred E. Darley, Marmaduke F. Purcell and Samuel Geoghegan, Dublin, Ireland. In this process the purified carbonic acid is finally compressed to liquefaction.

**472,091.**—Manufacture of blue dye. Arthur Weinberg, Frankfort-on-the-Main, Germany.

A mixture of monoalkylated orthotoluidine with metaoxybenzaldehyde is heated in presence of a condensing agent, such as hydrogen chloride, the product is then treated with strong sulphuric acid until the aqueous sol. of the sample is no longer precipitated by sodium acetate, and finally the leuco sulpho acids are oxidized by means of an alkaline bichromate, or of peroxides, such as lead peroxide.

The blue coloring matter has the constitution.



A dark blue powder easily sol. in water, difficultly sol. in spirits. The blue aqueous solution is not altered by addition of sodium carbonate but if strongly acidulated the color turns into yellow. Reducing agents transform the color into a leuco compound.

**472,121.**—Manufacture of yellow dyes. Meinhard Hoffmann, Mainkur, Germany. "The yellow dye-stuff derived from tetrazonaphthalinebeta-disulpho acid and phenols, which is easily soluble in water, difficultly sol. in spirit, dissolving with a brilliant violet shade in strong sulphuric acid from which on diluting with some water the free acid of the dye-stuff separates in the form of a dark green precipitate, which by further addition of water, is dissolved with a yellow shade."

**472,144.**—Gas stove. James L. Sharp, New Rochelle, N. Y.

**472,191.**—Apparatus for manufacturing gas. Charles W. Isbell, New York, N. Y.

**472,198.**—Gas burner for heating purposes. Peter H. Nelson, Chicago, Ill.

**472,209.**—Vacuum pan. John R. Farnharn, Brooklyn, N. Y.

**472,226.**—Hydrocarbon burner. Miles E. Ray, Toledo, Ohio.

**472,230.**—Process of decorating glass. John H. Scharling, Newark, N. J.

The process consists in repeatedly pouring a solution of metallic salts over the article to be decorated until the same is completely covered, “slowly turning or moving the article during such process, and finally subjecting said article to the action of an electroplating bath.”

**472,231.**—Hydrocarbon burner. George H. Scott, Worcester, Mass.

**472,255.**—  
**472,556.**— } Temperature regulators. Lucien F. Easton, La Crosse, Wis.

**472,261.**—Thermo-electric battery. Robert J. Gülcher, Berlin, Germany.

**472,267.**—Process of dyeing. Ernst Michaelis and Carl Henning, Cottbus, Prussia, Germany.

The process “consists in immersing the textile material in separate quantities in a bath consisting of an ‘acid’ solution, formed by heating zinc with sodium bisulphite mixed with caustic soda and indigo, adding to the bath from time to time additional amounts of the said ‘acid’ solution as additional quantities of the textile material are immersed therein, so that the bath may have a uniform alkaline reaction, and immersing each quantity of textile material as it comes from the bath in oxygenated water, whereby the indigo is oxidized.”

**472,322.**—Composition for retarding the solidification of calcined gypsum. Edward Watson, Grand Rapids, Mich.

**472,323.**—Drying Apparatus. Richard White, London, England.

**472,327.**—Dye-tub. Chas. L. Auger, Paterson, N. J.

**472,352.**—Compound for insulating electric wire. Louis Hill, Waterbury, Conn.

Consists of “pittigite pitch, candle tar, coal tar, asphalt pitch and rosin.”

**472,362.**—Machine for bottling aerated liquid. Frederic J. Johnston, Cambridge, and Nelson F. Hallett, Boston, Mass.

**472,367.**—Crushing and grinding mill. George S. Knapp, Chicago, Ill.

**472,368.**—Bottle washing machine. Lebbeus A. Koplin, Akron, Ohio.

**472,369.**—Facing compound. Charles F. Lawton, Rochester, N. Y.

**472,382.**—Milk tester. Ralph Messenger, Unadilla, N. Y.

**472,387.**—Method of treating and concentrating pyritiferous ores. James W. Neill, Leadville, Col.

**472,394.**—Vapor burner. Charles A. Pope, Cleveland, Ohio.

**472,421.**—Apparatus for disintegrating, mixing and other purposes. James A. Young, Boston, Mass.

**472,422.**—Metallurgical process. José B. Alzugaray, Porto, Portugal.

**472,433.**—Machine for classifying or sizing ores and like materials. Thomas Clarkson, London, Eng.

**472,498.**—Apparatus for condensing nitric acid. Oscar Guttman, London, Eng.

**472,502.**—Apparatus for coating metal plates. Edwin R. Jones, Swissvale, Pa.

**472,506.**—Spirit lamp. Abram C. Monfort, Pawtucket, R. I.

**472,511.**—Wall plaster. Walter Robinson, Syracuse, N. Y.

*Issued April 12, 1892.*

**472,547.**—Filter pump. Hermann Nordtmeyer, Breslau, Germany.

**472,614.**—Process of distilling carbonaceous material. Benjamin Brazelle, St. Louis, Mo.

**472,621.**—Process of making coke. Frederick J. Jones, Bedford, Eng.

**472,641.**—Apparatus for purifying water. Leroy S. Lewis, East Hartford, Conn.

**472,644.**—Food product. Clifford Saville, New York, N. Y.

**472,668.**—Process of making aluminates of alkalies. Emil Fleischer, Wiesbaden, Germany.

**472,682.**—Means of dry separation of materials of different specific weight and different size. Hermann Pope and Wilhelm Henneberg, Hamburg, Germany.

**472,691.**—Art of making tin plates. George H. Benjamin, New York, N. Y.

**472,697.**—Furnace. Simeon Bunn, Belleville, Ill.

**472,701.**—Process of tanning hides. Hermann Endemann, Brooklyn, N. Y.

The process consists in treating the hides with a chrome solution and then subjecting them to the action of a solution of cuprous salt.

**472,738.**—Brick-kiln furnace. William H. Martin, Covington, Ky.

**472,753.**—Ore screening apparatus. Thomas A. Edison, Llewellyn Park, N. J.

**472,759.**—Puddling furnace. Henry B. Hall, Hero, Pa.

**472,773.**—Refrigerator. William Simms, Minneapolis, Minn.

**472,785.**—Gas making apparatus. Charles R. Collins, Philadelphia, Pa.

**472,812.**—Art of making portraits or other pictures. Francisco Piera y de Mata, Havana, Cuba.

**472,820.**—Phosphate washing machine. George W. Roberts, Chisholm's Island, S. C.



**472,828.**—Iodine derivatives of acetyl paramidophenetole. Ludwig Scholvein, Berlin, Germany.

Process of obtaining iodophenin by combining a solution of acetyl paramidophenetole with a solution of iodine.

Iodophenin melts under decomposition at 130° C., is readily soluble in glacial acetic acid, not so readily in acetic acid of 50%, quite soluble in alcohol, difficultly soluble in benzole and chloroform, nearly insoluble in water, readily yields its iodine to an alkali or a boiling solvent, and has the empirical formula  $C_{20}H_{25}N_2O_4I_2$ .

**472,830.**—Combined churn and butter worker. Eric Silen, Kelso, Wash.

**472,848.**—Ore-roasting furnace. George F. Bartlett and Augustus J. O'Neill, Butte City, Mont.

**472,910.**—Safety vessel for oils. Charles J. Ryder, Patchogue, N. Y.

**472,925.**—Emulsion. Simon de Jager, Denver, Col.

**472,926.**—Continuous brick kiln. William Johnson, Leeds, Eng.

**472,936.**—Cooling room for breweries. Charles D. Stanford, Boston, Mass.

**472,945.**—Ornamenting candles. Thomas V. Forster, Avalon, Pa.

**472,949.**—Injector. Franz Kelch, Berlin, Germany.

*Issued April 19, 1892.*

**472,980.**—Device for preserving dried flowers. Frederick T. Brown, Colorado Springs, Col.

**472,981.**—Smoke consumer. William H. Burden, Cleveland, Ohio.

**472,984.**—Machine for making asphalted sheet metal. John P. Culver, Los Angeles, Cal.

**472,988.**—Machine for decorticating jute, ramie and other fibrous plants. Felix B. Fumerey, Galveston, Tex.

**472,989.**—Process of purifying cane juice. William V. Fry, Lambayeque, Peru.

A decoction of eucalyptus in treating the juice.

**473,005.**—Centrifugal cream separator. Carl A. Hult, Stockholm, Sweden.

**473,006.**—Receptacle for aerated liquids. Joseph D. Iler, Kansas City, Mo.

**473,009.**—Method of and apparatus for lining water channels. Charles H. Lyon, Ballance, near Ballan, Victoria.

**473,013.**—Apparatus for separating natural gas from oil, water, etc. William Moore, Kokoin, Ind.

**473,046.**—Rotary water meter. Theodore Woollens, Jr., Cheyenne, Wy.

**473,066.**—Ore separator. Simon G. Elliott, Quincy, Mass.

**473,081.**—Funnel. Rudolph Rahn, St. Louis, Mo.

**473,104.**—Amalgamating apparatus for separating gold and other metals from their ores. George J. Atkins, London, Eng.

**473,105.**—Electrolytic apparatus for separating gold and other metals from their ores. George J. Atkins, London, Eng.

**473,106.**—Apparatus for pickling metal plates. William H. Atkinson and Daniel M. Somers, Brooklyn, N. Y.

**473,110.**—Machine for decorticating ramie. Pierre P. Faure, Limoges, France.

**473,117.**—Electrode for use in electro-metallurgical processes. Paul Héroult, Neuhausen, Switzerland.

**473,118.**—Apparatus for producing aluminium or other metals. Paul Héroult, Laupfen, Switzerland.

**473,143.**—Gas retort charger. André Coze, Rheims, France.

**473,144.**—Apparatus for charging gas retorts. André Coze and Alex. Lencauchez, Paris, France.

**473,145.**—Gas retort. André Coze and Alexandre Lencauchez, Paris, France.

**473,146.**—Secondary battery. Harry E. Dey, New York, N. Y.

**473,147.**—Secondary battery. Harry E. Dey, New York, N. Y.

**473,156.**—Refrigerating machine. Daniel L. Holden, New York, N. Y.

**473,157.**—Refrigerating apparatus. Daniel L. Holden, New York, N. Y.

**473,164.**—Apparatus for distilling water. William Rochlitz, Chicago, Ill.

**473,165.**—Oil burning device. Henry T. Russell, Chicago, Ill.

**473,176.**—Refrigerating apparatus. Daniel L. Holden, New York, N. Y.

**473,186.**—Method for producing metallic zinc.

**473,252.**—Furnace for burning liquid fuel. Stephen Fox, Jr., Bridgeton, N. J.

**473,266.**—Machine for cleaning and soaping fabrics. Ethelbert A. Rusden, Providence, R. I.

**473,280.**—Crushing mill. Frederick A. Wiswell, Lynn, Mass.

**473,293.**—Gas engine. James A. Charter, Sterling, Ill.

**473,301.**—Brick and tile cutting machine. Richard A. Drawdy, Jacksonville, N. Y.

**473,306.**—Compound of sulphurated oils. Walter D. Field, Millburn, N. J.  
Compounds consisting of "the glyceryl or glyceryl ethers of the unsaturated fatty acids, combined with sulphur to form sulphur-balsam and pyroxyline or nitro-cellulose."

**473,322.**—Centrifugal machine. John Laidlaw, Glasgow, Scotland.

**473,326.**—Oil purifier. Rudolph Metz, Philadelphia, Pa.

**473,331.**—Medicinal food. Andrew D. McKay, Liverpool, England.

This food consists of dextrin, egg albumen, pepsin, iron hypophosphite, calcium hypophosphite, and sodium hypophosphite.

**473,350.**—Apparatus for the manufacture of gas. Gottlieb Scharfe, Annapolis, Md.

**473,382.**—Method and apparatus for making metal castings. William L. Clark, Sioux City, Iowa.

**473,385.**—Amalgamator. Wilton E. Darrow, Amador, Cal.

**473,391.**—Paint. Julius Haake, Radebeul, Germany.

**473,395.**—Art of amalgamating silver ores. Alexis Jarvin, San Francisco, Cal.

**473,421.**—Machine for pulverizing sods, manure, etc. Benjamin F. Knapp, Madison, N. J.

*Issued April 26, 1892.*

**473,449.**—Ore concentrator. Gustavis L. Cudner, New York, N. Y.

**473,450.**—Combined ore separator and amalgamator, Gustavis L. Cudner, New York, N. Y.

**473,451.**—Placer disintegrator and amalgamator. Gustavis L. Cudner, New York, N. Y.

**473,452.**—Hot air evaporator or drier. John H. Crozier, Bean's Station, Tenn.

**473,453.**—Red dye. Max Epting, Höchst-on-the-Main, Germany.

A dye "derived from triamidotriorthotolylcarbinol, which in the form of its sodium salt is a green mass having metallic lustre, of easy solubility in water, but insoluble in absolute alcohol."

**473,463.**—Plunge battery. James H. Howard, Medford, Mass.

**473,466.**—Manufacture of steel ingots. Charles W. Kennedy and John W. Grantland, Philadelphia, Pa.

**473,467.**—Process of making naphthosulfondisulphonic acid. Hans Kuzel, Höchst-on-the-Main, Germany.

**473,473.**—Machine for centrifugally treating molten material. Orrin B. Peck, Chicago, Ill.

**473,475.**—Combination hot-water and hot-air heater. Frank C. Peteler, Minneapolis, Minn.

**473,489.** ) Sewerage System, etc. Stephen E. Babcock, Little Falls,

**473,490.** ) N. Y.

**473,498.**—Carburetor. Henry L. Cruttenden, Northfield, Minn.

**473,505.**—Soap press. Charles Hupf, Cincinnati, Ohio.

**473,506.**—Ore concentrator. Frank M. Iler, Marion, Ohio.

**473,509.**—Vacuum pump. Whitcomb L. Judson, New York, N. Y.

**473,511.**—Centrifugal machine for refining starch. George A. Kerr, Columbus, Ind.

**473,514.**—Induction discharge protector for welding apparatus. Hermann Lemp, Lynn, Mass.

**473,530.**—Agitator. Richard Smith, Sherbrooke, Canada.

- 473,588.**—Amalgamator. Bryan Tyson, Washington, D. C.
- 473,560.**—Salt grainer. Nathan S. Scoville, Warsaw, N. Y.
- 473,681.**—Fumigator. Hugo F. Loepere, Buffalo, N. Y.
- 473,686.**—Temperature regulator. James F. McElroy, Albany, N. Y.
- 473,644.**—Concentrator. Adolph Schulenburg, San Francisco, Cal.
- 473,659.**—Art of distillation and apparatus used therefor. Arthur W. Ellis, London, Eng.
- 473,679.**—Coloring and burnishing composition. James F. Thompson Rockland, Mass.
- 473,685.**—Gas engine. Carl W. Weiss, Brooklyn, N. Y.
- 473,705.**—Process of treating wood to prevent decay. Marcus A. Luck-  
erbach, Denver, Col.
- 473,722.**—Safety vent for steam apparatus. William C. Baker, New  
York, N. Y.
- 473,725.**—Stone or ore crushing machine. Edgar H. Booth, San Fran-  
cisco, Cal.
- 473,741.**—Method for smelting cast iron borings, turnings, and shavings.  
Jens Hansen, Helsingør, Denmark.
- 473,753.**—Making relief plates by photography. Jacob Husink, Prague,  
Austria, Hungary.
- 473,767.**—Process of improving oil paintings by photography. Ludwig  
Meyer, Berlin, Germany.
- 473,776.**—Method of and means for bottling liquids and sealing bottles.  
William Painter, Baltimore, Md.
- 473,790.**—Zinc foil and method for manufacturing the same. Albert  
Sichel, New York, N. Y.
- 473,793.**—Cooling apparatus. Sherman L. Smith, Plymouth, Pa.
- 473,805.**—Tanning compound. Samuel W. Wright, Mountain Grove,  
Mo.
- 473,828.**—Device for cementing wells and cisterns. William' H. H.  
Davis, Oakfield, Mich.
- 473,834.**—Fuel press and cutter. Gustave Frank, New York, N. Y.
- 473,841.**—Manufacture of carbon blocks. Leon Hulin, Frozes, France.
- 473,860.**—Art of making mortar. Edward T. Warner and John C.  
Curry, Wilmington, Del.
- 473,866.**—Process of obtaining metals from their ores or compounds.  
Chas. S. Bradley, Yonkers, N. Y.
- 473,876.**—Condenser for refrigerating or ice making machines. Horace  
F. Hodges and David J. Havenstrite, Boston, Mass.
- 473,884.**—Process of and apparatus for welding metals. Charles E.  
Lipe and John A. Pross, Syracuse, N. Y.
- 473,893.**—Preserving animal food. James W. Cameron, New York,  
N. Y.



REGULAR MEETING, MAY 6, 1892.

The meeting was called to order at 8:30 P. M., Prof. A. A. Breneman in the chair.

The minutes of the April meeting were read and accepted.

The following members were elected :

Prof. A. E. Menke, Industrial University, Fayetteville, Ark.

Dr. Leo Baekeland, 1964 Seventh Avenue, N. Y.

Dr. S. Burton, Waco, Texas.

Mr. John T. Enequist, Bushwick Chemical Works, Brooklyn, N. Y.

Mr. Roland Molineaux, 108 Fulton Street, N. Y.

From associate to regular membership:

Mr. Ottomar Eberbach.

Mr. Wm. F. Edwards, Ann Arbor, Mich.

The following nominations were made:

Dr. J. E. Blomeis, Landing, N. J.

Dr. Walker S. Haines, Rush Medical College, Chicago, Ill.

Dr. Wm. M. New, Washington, D. C.

Mr. Wm. H. Seaman, 1424 11th Street, Washington, D. C.

Ernst Speidel, B. Sc., 19 Quincy Street, Chicago, Ill.

Mr. W. M. Stiles.

Dr. Herman T. Vulté, School of Mines, N. Y.

Dr. Frederic Zinsser, 501 West 58th Street, N. Y.

The chair announced the death of Dr. A. W. von Hofmann, of Berlin, an honorary member of the Society.

The following message was received by cable and read by the Secretary :

“ BERLIN, May 6, 1892.

“ *To the Pres't and Council of the American Chemical Society :*

“ In the name of the German Chemical Society, I have the sad duty to inform you of the death of our President, August Wilhelm von Hofmann.

(Signed) C. A. MARTINS, *Vice-Pres't.*”

Dr. Loeb moved that a committee of three be appointed to draft resolutions in regard to the death of Prof. A. W. von Hof-

mann, of Berlin, to be spread upon the minutes of the Society, and that a copy of these resolutions be sent to the Berlin Chemical Society.

Carried.

The chair appointed Dr. Morris Loeb, Dr. H. Carrington Bolton and Dr. A. R. Leeds.

It was also directed that an order be cabled to Berlin to place a wreath upon the coffin of Prof. Hofmann, in the name of the American Chemical Society.

After some discussion in reference to holding a general meeting of the Society in August, the meeting was adjourned.

DURAND WOODMAN,  
*Recording Secretary.*

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### THE NEW YORK SECTION.

A special meeting of the New York Section for the purpose of organization was held at the University building, in the Law lecture room, April 29, 1892, at 8:15 P. M.

The committee on organization, appointed at the April meeting of the Society, presented through its chairman, Prof. McMurtrie, the following :

#### *Rules for the Government of the New York Section of the American Chemical Society.*

1. The officers of the Section shall consist of a Chairman, a Secretary and Treasurer (combined in one person), an Executive Committee, consisting of the officers above named, and three additional members of the Section.

2. The officers shall be elected annually by ballot after nomination in open meeting, in the first meeting of the year, which shall be held on the first Friday of October. Officers who shall serve for the remainder of the current year shall be elected in accordance with these provisions immediately after they shall have been adopted.

3. The Section shall hold nine meetings during the year, one upon the first Friday of each month except July, August and

September. Special meetings may be called at any time at the discretion and by order of the Executive Committee.

4. No papers may be read in open meeting until they have been approved by a majority of the Executive Committee.

5. The Treasurer shall annually report to the Executive Committee and his report and accounts shall be examined and audited by a committee of two to be appointed by the Chairman of the Section.

6. The Section shall be otherwise governed and controlled by the provisions of the general constitution of the Society.

The report of the committee was accepted and the rules were adopted as the laws of the New York Section.

An election for officers of the Section under the above rules was then held with the following result :

Chairman, A. H. Sabin ; Secretary and Treasurer, Morris Loeb ; members of the Executive Committee, H. C. Bolton, William McMurtrie, A. A. Breneman.

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#### THE FIRST REGULAR MEETING OF THE SECTION.

The first regular meeting of the New York Section was held at the close of the regular May meeting of the Society, May 6.

A paper "on the application of graphic methods in certain chemical studies," by A. Bourgougnon, was read by the Secretary in the absence of the author.



## ON THE APPLICATION OF GRAPHIC METHODS IN CERTAIN CHEMICAL STUDIES.

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By A. BOURGOUNON.

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The graphic methods so generally applied in the different branches of science possess the great advantage of representing physically to the eye laws deduced from the observation of certain phenomena or metaphysical conceptions, laws generally expressed by complicated equations of which the solution would involve impracticable calculations. In a general manner, the more complicated and difficult of conception by our mind is a physical law, the higher is the degree of the equation or empirical formula which embodies it. When applied to the study of the laws of gravitation for instance, to quote a well known example, this graphic method furnishes curves from which can be at once calculated by measurements on a diagram, the principal data of a given question. Transported to the domain of chemistry the method is found very useful for the solution of many problems.

The curve of solubility of certain salts of which the solubility varies with the temperature furnishes at once the amount of such salts in solution in water at different temperatures.

When saline solutions are used for certain specific purposes similar curves constructed from actual observations of the densities of different saturations or the degree they show with a given areometer, can give readily the amount of the salt to be dissolved in a certain amount of water to obtain the density required, or vice versa.

If we pass from these simple examples to curves representing certain conceptions of the intimate constitution of matter, the use of graphic methods proves equally advantageous.

A curve reproducing the results of certain observations may

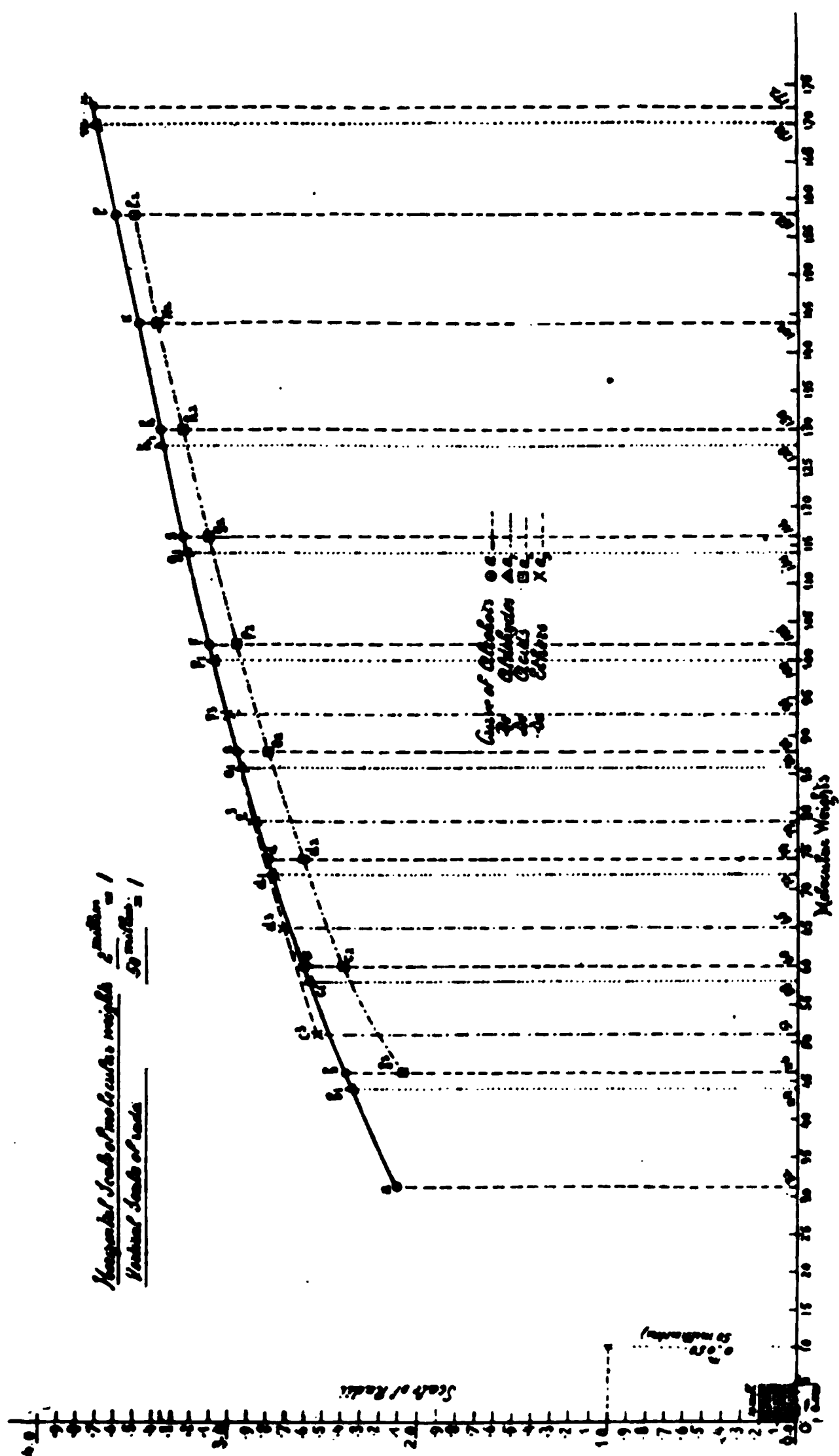
and will often present "breaks" or solutions of continuity, and a consideration of these missing parts may prove the means of discovering the probable properties of an unknown compound, which, graphically, would find its place at such a point. We may mention as an example the well known curve of Mendelejeff, embodying a classification of the elements. Without entering into a discussion of the question if this curve does really or not represent a natural classification of the elements, it is well known that by the consideration of some missing points of the curve, it has been possible for Mendelejeff to foresee that the "gap" observed at certain points would have to be filled by an element which, by its position between certain others of which the properties were known ought to possess certain characters of atomic weight, specific gravity, and even chemical affinities which the subsequent discovery of such an element has emphatically confirmed. In other cases these curves may serve as affording a corroboration, a control, of certain assertions generally admitted, and even if useful only to that extent, they would be very valuable. We have thought that in this line of investigation it might prove interesting to submit the results of some personal researches.

If the molecular weight  $W$  of a compound be divided by its specific gravity  $D$ , the quotient expresses the molecular volume of the compound

$$V = \frac{W}{D}$$

and this ratio of the molecular weight to the specific gravity can be easily computed in each particular case.

Of the nature of the atoms we do not know much, we are not in this respect any more advanced than the Greek philosophers were twenty centuries ago, we have no definite ideas of their shape, we do not know if their number is limited. We admit that under certain circumstances they can assume an individuality and form molecules which we consider as the smallest conceivable parts of matter which can pass into or out of combination; we admit also, that these molecules affect the spherical form, from which it can be inferred that a compound constituted by such molecules separated by intermolecular spaces will affect also a spherical form.



The graphic consideration of these molecular volumes for certain class of compounds give rise to interesting deductions. If, for instance, we consider the primary alcohols and their derivatives, aldehydes, acids, ethers, we know that, in each series of these compounds, the molecular weights proceed by regular and equal increments by the addition to the preceding term of the series of the molecular weight of the radicle which heads it. If we carry then on a horizontal line, taken as the axis of abscissae and at a proper scale, these equal increments from an assumed point O, and applying to each compound the proper molecular weight  $W$ , represented by a corresponding abscissa, we erect at each point, thus determined in the axis AX of abscissae, a perpendicular; by carrying on these ordinates the lengths measured at the same or any other scale assumed, for clearness of diagram, which represent the calculated molecular volumes  $V$  in each case and joining the points by a continuous curve we will obtain a curve which will be the graphical representation of the law by which, so to speak, we pass from one compound to the other. If it happens that certain of these compounds be unknown, the curve at the corresponding point (or the ordinate) will present a "gap," but the general curvature assumed will allow us to trace it, with a sufficient approximation, by joining the points corresponding to the term or terms of the series preceding and following the missing compound or compounds and we shall be able, by actual measurements of the missing ordinates thus supplied, to foresee very closely the physical characters of the missing term.

These molecular volumes being generally represented by numbers rather large may render the construction of the diagram on a scale sufficiently large rather difficult. They can be advantageously replaced by such quantities, proportional to them, as can be readily calculated, the volumes being known, for instance, the corresponding radii of the spheres which represent the molecular volumes.

We have then

$$\frac{W}{D} = V = \frac{4\pi}{3} R^3$$

and

$$R = \sqrt[3]{\frac{V}{4.1888}}$$

We have calculated such radii for the primary alcohols, their ethers, aldehydes and acids for the compounds of which the molecular weights  $W$  and specific gravities  $D$  are given below, calculating and tabulating first the molecular volumes from which the corresponding radii were deduced, and for each series or group of compounds we have constructed the special corresponding curve by carrying, as explained above, as abscissae the respective molecular weights in each case and as ordinates at each point thus determined on the line of abscissae the calculated radii of the spheres corresponding to the different molecular volumes.

## ALCOHOL.

	$W$	$D$	$V = \frac{W}{D}$	$R = \sqrt[3]{\frac{V}{4.1888}}$
$C_1H_4O$	32	0.8098	39.5159	2.112
$C_2H_6O$	46	0.812	56.6502	2.382
$C_3H_8O$	60	.820	73.170	2.593
$C_4H_{10}O$	74	.824	89.805	2.778
$C_5H_{12}O$	88	.83	106.204	2.939
$C_6H_{14}O$	102	.8312	122.7141	3.082
$C_7H_{16}O$	116	.838	138.4248	3.209
$C_8H_{18}O$	130	.8375	155.2238	3.333
$C_9H_{20}O$	144	.8415	171.1229	3.444
$C_{10}H_{22}O$	158	.8389	188.3418	3.555
$C_{11}H_{24}O$	172	.8268	208.0430	3.675

## ALDEHYDES.

$C_1H_2O$ Gas.				
$C_2H_4O$	44	.807	54.5229	2.351
$C_3H_6O$	58	.83	69.8795	2.555
$C_4H_8O$	72	.834	86.3309	2.741
$C_5H_{10}O$	86	.822	104.6228	2.923
$C_6H_{12}O$	100	.842	118.7648	3.057
$C_7H_{14}O$	114	.827	137.8476	3.204
$C_8H_{16}O$	128	0.82	156.0975	3.340
$C_9H_{18}O$ ?				
$C_{10}H_{20}O$ ?				
$C_{11}H_{22}O$	170	.85	200.00	3.627

ACIDS.

$C H_2 O_2$	46	1.245	36.9477	2.066
$C_2 H_4 O_2$	60	1.0701	56.0695	2.374
$C_3 H_6 O_2$	74	1.0154	72.8776	2.591
$C_4 H_8 O_2$	88	0.9746	90.2934	2.783
$C_5 H_{10} O_2$	102	.9562	106.6722	2.941
$C_6 H_{12} O_2$	116	.9446	122.8033	3.083
$C_7 H_{14} O_2$	130	.935	139.0374	3.213
$C_8 H_{16} O_2$	144	.9139	157.5664	3.350
$C_9 H_{18} O_2$	158	.9082	173.9704	3.463

ETHERS.

$C H_3 O \frac{1}{2}$ Gas.				
$C^2 H_5 O \frac{1}{2}$	37	.735	50.3401	2.290
$C_3 H_7 O \frac{1}{2}$	51	.763	66.8414	2.517
$C_4 H_9 O \frac{1}{2}$	65	.784	82.9081	2.704
$C_5 H_{11} O \frac{1}{2}$	79	.799	98.8735	2.846
$C_6 H_{13} O \frac{1}{2}$	93.	.862	107.8886	2.953

The specific gravities are for the temperature of  $0^\circ C$ . and have been obtained from Prof. Clarke's "The Constants of Nature."

Instead of writing the formulæ of the ethers  $\frac{C_n H_{n+1}}{C_n H_{n+1}} > O$  their molecule has been halved so as to obtain volumes comparable with the volumes given by the alcohols, aldehydes and acids, and this has been done only as a matter of convenience in calculation, bearing in mind, however, that the formulæ represents only half a molecule which, according to present chemical theories, cannot exist.

In the series of the aldehydes we have omitted the methylic aldehyde which is a gas, beginning the curve only at the next liquid compound. The aldehydes  $C_9 H_{18} O$ ,  $C_{10} H_{20} O$  are unknown at these points, the curve is supplied from the general radius of curvature it assumes. The interpolated curves would furnish at once very approximately the corresponding ordinates, and by measuring these ordinates on the scale the radii of the spheres, representing the molecular volumes could be obtained. From these radii the molecular volumes could be readily calculated, and

as the abscissae corresponding to the measured ordinates are known and furnish the molecular weights, the specific gravity  $D = \frac{W}{V}$  could be obtained. The properties of these unknown aldehydes could be also inferred from the fact of their falling between two of which the properties have been already ascertained. In the same manner the curve might serve as control for results already obtained; any important deviation from the general curvature at some point corresponding to a new compound, which might have been furnished by an ordinate calculated as explained, would justify a revision of the results accepted for this compound, of its specific gravity for example.

An inspection of the diagram in which all the curves have been plotted on the same scale show how closely the alcohol and aldehyde curves especially and even that furnished by the ethers follow each other; practically they cover each other and give one and the same curve if we consider how large the vertical scale has been taken in proportion to the horizontal one; in this diagram it is twenty-five times as large and any discrepancy shows itself much magnified. The curve of the acids is decidedly different and falls below the others, but keeping in mind always the large vertical scale adopted it follows still closely the other in general curvature though apparently nearing them as it recedes from the origin.

This rapid examination of one particular class of compounds may serve to show the utility of graphic methods in pointing the way to the discovery of some errors in the determination of certain properties of a compound or in calling the attention on certain anomalies made apparent, so to speak, in a physical manner.

In pursuing this line of investigation in a summary manner, if we compare together the elements taken in the gaseous state under a condensation of 2 volumes and calculate the radii of their molecular volumes as explained above we obtain a curve which demonstrates graphically the known fact that under these condition the elements occupy in space the same volume.

$$O_2 = R \ 1.904$$

$$H_2 = R \ 1.902$$

$$N_2 = R \ 1.902$$

$$\begin{aligned}\text{Cl}_2 &= R \ 1.908 \\ \text{Br}_2 &= R \ 1.903 \\ \text{I}_2 &= R \ 1.909 \\ \text{S}_2 &= R \ 1.902\end{aligned}$$

If we calculate in the same manner the radii of the spheres representing the molecular volumes of gaseous compounds, we find

$$\begin{aligned}\text{NH}_3 &= R \ 1.900 \ 2 \text{ volumes} \\ \text{H}_2\text{O} &= R \ 1.904 \\ \text{CO}_2 &= R \ 1.900 \\ \text{SO}_2 &= R \ 1.898 \\ \text{SO}_3 &= R \ 1.904 \\ \text{CO} &= R \ 1.904 \\ \text{As H}_3 &= R \ 1.904 \\ \text{PH}_3 &= R \ 1.899 \\ 2 \ (\text{CH}_3) &= R \ 1.904 \\ 2 \ (\text{C}_2\text{H}_5) &= R \ 1.891 \\ \text{CS}_2 &= R \ 1.900 \\ \text{—Me} \\ \text{N—H} &= R \ 1.899 \\ \text{—H}\end{aligned}$$

All these numbers are practically equal, and, in fact, the differences observed are so small that they might be due to errors of observation. The curve which will represent these molecular volumes, as given by their radii, is, in fact, a straight line parallel to the axis of abscissae at a distance of 1.90, all the ordinates being equal.

With this constant radius equal to 1.90, we can calculate the hypothetical specific gravity in the gaseous state of bodies that we cannot volatilize, carbon, for example.

The formula

$$\frac{4\pi}{3} R^3 = V$$

gives

$$1.9^3 = 6.859 \times 4.1888 = 28.7309$$



and

$$\frac{W}{V} = D$$

$$\frac{24}{28.7309} = 0.835$$

Büchner gives the number 0.8316.

There are, however, some exceptions.

Mercury, taken as equal to two volumes of vapor, will give 2.392 for the number corresponding to its radius; but if we reduce the two volumes to one, we will have

$$Hg'' = R \ 1.898$$

For phosphorus and arsenic the nearest numbers to the constant 1.90 are obtained with

$$P_4 = R \ 1.895$$

$$As_4 = R \ 1.890$$

Therefore as 1 atom of mercury occupies the same volume as 2 atoms of hydrogen, the atom of mercury is twice the bulk of an atom of hydrogen and the atom of phosphorus and of arsenic in the vapor state occupies only one-half the bulk of an atom of hydrogen.

Since this paper has been read before our Society, I have found a very able and very interesting communication from Mr. A. J. Rossi in the "Iron Age." In this paper Mr. Rossi, in adapting the use of a graphic method, shows that, knowing the analysis of an iron ore, a lime stone and the amount and composition of the ash contained in the fuel to be employed, the charges of a blast furnace corresponding to a certain grade of iron and consequently to a slag of a given composition and fusibility can be obtained without calculation.

#### CONSTRUCTION OF THE DIAGRAM.

The use of profile paper ruled to the millimeter is very convenient for such diagrams.

We have carried the molecular weights on the line of abscissae at a scale of two millimeters for one of molecular weight and the

paper being divided to the millimeter we could even estimate a fractional number very closely.

The vertical scale has been taken equal to twenty-five times the horizontal scale, fifty millimeter vertical representing a radius of 1, five millimeter a radius of 0.1 and every millimeter a radius of 0.02. As we can accurately estimate one-half of the smallest division of the paper we see that the radius can be read exactly to the second decimal. To render the construction of each curve easier to understand we have plotted the ordinates or radii of all the points determined in distinct lines down to the line of abscissae, marking at the foot of each ordinate the abscissae or molecular weight which correspond to it in the tables.

## Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

Issued May 3, 1892.

**473,928.**—Process of dyeing black. Meinhard Hoffmann, Mainken, near Frankfort-on-the-Main, Ger.

The material is first dyed with the coloring matter named “naphthaline violet” and then treated with nitrous acid, and finally passed through a solution of phenol or an amine.

**473,957.**—Coal washing and separating machine. James Pollock, Wilkesbarre, Pa.

**474,005.**—Rotary drying machine. Richard E. Fischer, Baltimore, Md.

**474,014.**—Gold concentrator. William H. Hill, Atlanta, Ga.

**474,019.**—Apparatus for wasting and smelting. Robert H. Lanyon, Nevada, Mo., and William Lanyon, Pittsburg, Kan.

**474,022.**—Process of separating and cleaning coal and other minerals. Carl Lührig, Dresden, Ger.

**474,023.**—Apparatus for washing, separating and concentrating ores of different specific gravity. Carl Lührig, Dresden, Ger.

**474,034.**—Air compressor. Benjamin F. Teal, Chicago, Ill.

**474,035.**—Atomizer. Victor C. Vant Woud, Brooklyn, N. Y.

**474,036.**—Funnel. Alhana P. Wood, Atlanta, Ga.

**474,044.**—Machine for filling and corking bottles. Henry Heartfield, Croydon, Eng.

**474,052.**—Fiber preparing machine. John L. Acosta, Vera Cruz, Mexico.

**474,063.**—Atmospheric gas burner. Charles M. Lungsén, Brooklyn, N. Y.

**474,087.**—Machine for drying textile fiber. William Hartley, Jr., Lonsdale, R. I.

**474,095.**—Ore pulverizer. William L. Morris, Cleveland, Ohio.

**474,099.**—Method of preparing figs. George W. Reamer, Forest Hill, Cal.

The figs are subject to the action of steam to soften and clean them and after expression of part of the juice reduced to any suitable form.

**474,119.**—Glass grinding machine. Robert Friedel, Stuttgart, Ger.

**474,135.**—Safety appliance for steam boilers. John Kastner, Jr., Evansville, Ind.

**474,160.**—Separator for purifying steam. David Cochrane, Philadelphia, Pa.

**474,178.**—Gas generating apparatus. William H. Morgans, Pontiac, Mich.

**474,201.**—Apparatus for making gas. Paul A. N. Winand, Philadelphia, Pa.

**474,202.**—Gas producer. Paul A. N. Winand, Philadelphia, Pa.

**474,241.**—Water or gas meter. John Goodman and Henry Goodman, Louisville, Ky.

**474,253.**—Composition of matter for spinning rings, etc. Rose A. Johnson, Manchester, and Robert Brewster, New Barnet, Eng.

The composition consists of fifty parts feldspar, fifty parts rock crystal, thirty parts china clay, and thirty parts of a flux, such as borax.

**474,267.**—Microscopic sediment filter. Porter W. Shimer, Easton, Pa.

**474,272.**—Ore concentrator. Crighton R. Townsend, Idaho Springs, Col.

**474,295.**—Anti-friction alloy. John Fowler, Louisville, Ky.

An alloy of antimony, copper and phosphor-tin is first prepared and then fused with block tin.

**474,305.**—Drier. James G. Sanderson, New York, N. Y.

**474,326.**—Siphon bottle filling machine. Frederic J. Johnson, Cambridge, and George E. Barton, Somerville, Mass.

**474,344.**—Apparatus for generating heat. Henry A. Ramsay, Baltimore, Md.

*Issued May 10, 1892.*

**474,354.**—Middlings purifier. Seth H. Baker and James H. Verity, Rapidan, Minn.

**474,389.**—Centrifugal machine. Hugh W. Lafferty, Wilmington, Del.

**474,412.**—Machine for forming fuel bricks. Johann P. Schmidt, Jersey City, N. J.

**474,413.**—Art of and apparatus for aerating liquids. Joseph Schneible, Brooklyn, and Carl A. Schneible, New York, N. Y.

**474,414.**—Apparatus for aerating liquids. Carl A. Schneible, New York, and Joseph Schneible, Brooklyn, N. Y.

**474,419.**—Process for making fertilizers. Thomas M. Smith, Baltimore, Md.

**474,434.**—Paint oil. George W. Bankers, Brooklyn, N. Y.

A paint oil composed of a solution of naphthaline in fish oil.

**474,443.**—Alloy. Ernest W. Cooke, Chicago, Ill.

An alloy of iron, aluminium and copper and containing at least 75% of iron.

**474,446.**—Apparatus for pickling meat. Johann Fey, Offenbach-on-the Main, Ger.

**474,454.**—Exciting fluid for galvanic batteries. Carl Lützke, Jr., Berlin, Ger.

A concentrated solution of one or several of the chlorides of copper, iron, zinc, etc., in combination with two to three parts by weight of nitrate of mercury.

**474,481**.—Gas regulator. Michael O'Gorman, Jersey City, N. J.

**474,490**.—Dust collector. George Walter, Duluth, Minn.

**474,491**.—Dust collector. George Walter, Thief River Falls, Minn.

**474,496**.—Apparatus for molding earthenware, etc. Joseph Crossley, Trenton, N. J.

**474,510**.—Bottle-washing machine. Jacob F. Wittemann, Fort Hamilton, N. Y.

**474,518**.—Machine for combing fiber. David Barnett and David Black, Bradford, Eng.

**474,527**.—Sulphuric acid pan and process of making the same. Richard Kûch, Hanau-on-the-Main, Germany.

Platinum is heated to a degree higher than the melting point of gold and then molten gold is poured upon the same, thus alloying the two surfaces and coating the platinum with a layer of gold.

**474,529**.—Manufacture of explosives. Frank Roller, West Berkeley, Cal.

Nitrates or other gas producing compounds or materials are covered with a coating of colophony in an oil.

**474,531**.—Process of roasting coffee. Carl Salomon, Brunswick, Ger.

The coffee is first exposed directly to contact with gases heated to a high temperature until the empyreumatic matters are driven off and the aromatic qualities developed as indicated by the alkaline reaction of the escaping gases. The wasted material is then quickly cooled.

**474,539**.—Process of and apparatus for making silicates and hydrochloric acid. Walter Walker, Eng.

Sand is mixed with chloride of sodium and lime and the mass subjected to sufficient heat in the presence of moisture to form a silicate of soda and lime and to drive off the hydrochloric acid.

**474,542**.—Thermostat. Archibald H. Brintnell, Toronto, Can.

**474,561**.—Apparatus for the manufacture of explosives. Hiram S. Maxim, London, Eng.

**474,567**.—Process of galvanizing or tinning wire cloth. Charles B. Rumsey, Homer, N. Y.

**474,578**.—Ore roasting furnace. Horace F. Brown, Butte City, Mont.

**474,581**.—Process of preserving meat. José Mariosa, San Paulo, Brazil.

The meat is coated with a mixture consisting of about forty parts bicarbonate of soda and sixty parts of sugar and sufficient water to form a pasty mass and subjected to an air current to thoroughly dry the coating applied.

**474,585**.—Art of cleaning and washing raw sugar.

**474,591**.—Process of extracting gold from sulphide ores. Thomas A. Edison, Llewellyn Park, N. J.

**474,592**.—Ore conveying apparatus. Thomas A. Edison, Llewellyn Park, N. J.

**474,680.**—Apparatus for cooling and aerating malt liquors. Henry E. Deckebach, Cincinnati, Ohio.

**474,681.**—Low water alarm. Thomas A. Delaney and Robert E. Hills, Chicago, Ill.

**474,686.**—Mechanism for testing and recording the properties of flour. James Hogarth, Kirkcaldy, Scotland.

**474,687.**—Machine for making vessels from fibrous pulp. Eber Hubbard, Chicago, Ill.

**474,685.**—Water purifier. Arthur Pennell, Kansas City, Mo.

**474,698.**—Paint. Charles H. Reaney, Washington, D. C.

A paint consisting of "zinc oxide, red lead, drop ivory-black, pulverized slate, raw linseed oil, spirits of turpentine, oxide drier, bisulphide of carbon and pure rubber."

**474,702.**—Composition for leather dressing. James E. Swain, Baltimore, Md.

**474,714.**—Fiber machine. Luis Bacallado y Sanchez, Matanzas, Cuba.

**474,716.**—Machine for creasing powder-papers. Alfred G. Beale and Thomas Nesbitt, Tunbridge Wells, Eng.

**474,778.**—Process of making nitro-cellulose. Hudson Maxim, New York, N. Y.

*Issued May 17, 1892.*

**474,807.**—Continuous Kiln. Max R. Boehucke, Centinela, Cal.

**474,811.**—Baking powder. Charles A. Catlin, Providence, R. I.

A preparation composed of phosphoric acid in granular form and bicarbonate of soda.

**474,814.**—Process of preparing celluloid or similar materials for printing. Arthur A. C. de Coëtlogon, Paris, France.

**474,828.**—Medical battery. Philip Hathaway, New York, N. Y.

**474,829.**—Process of concentrating ores. Charles B. Hebron, Denver, Col.

**474,884.**—Non-conducting material. Henry W. Johns, New York, N. Y.

Composed of hair, asbestos, sponge and a disinfectant or insect destroying material.

**474,884.**—Carburetor. John W. Lambert, Ohio City, Ohio.

**474,850.**—Process of producing photographs on hard surfaces. Armand Müller Jacobs, New York, N. Y.

**474,864.**—Process of treating cottonseed oil. George W. Scollay, New York, N. Y.

Ochre is dried and then brought into intimate contact with the oil and finally separated from the refined oil. The ochre separating and carrying the impurities.

**474,865.**—Composition for use as ornamental moldings, etc. Oscar von Slama, Jersey City, N. J.

A plastic composition containing dextrine, sulphate of lime, silicate of soda, and vegetable fibers.

**474,880.**—Centrifugal machine for emulsifying liquids. George W. Towar, Jr., Detroit, Mich.

**474,922.**—Brick kiln. Stephen J. Plant, Momence, Ill.

**474,933.**—Furnace for the incineration of garbage. John Wilson, New York, N. Y.

**474,942.**—Manufacture of yeast. Jacob Blumer, Brooklyn, and Charles Schlagenhauser, New York, N. Y.

**474,943.**—Method of making yeast. Jacob Blumer, Brooklyn, and Charles Schlagenhauser, New York, N. Y.

**474,944.**—Process of making paper pulp. Norman H. Brokaw, Kan-  
kauna, Wis.

Sticks of wood are steamed or steeped to remove the resin and then cut into disks or chip and submitted to the action of sulphite liquor.

**474,957.**—Rheostat. Albert B. Herrick, Bayonne, N. J.

**474,961.**—Apparatus for heating and circulating water. Henry A. Jones and Joseph E. Marcy, New York, N. Y.

**474,965.**—Bottle filling machine. Willoughby M. McCormick, Baltimore, Md.

**475,025.**—Purifying and manufacturing saccharine solutions. Moriz Weinrich, St. Louis, Mo.

**475,050.**—Chemical fire extinguisher. Russell A. Ballou, Boston, Mass.

**475,060.**—Revolving waster. Rudolph Köhler. Lipine, Germany.

**475,062.**—Carbon product. Louis S. Langville, Troy, N. Y.

A product made "from the wood-cellulose and resinoid residuum of wood pulp manufacture, and in which the bulk of the silica of the wood-cellulose has been removed and the lighter carbon produced from the resinoid combined with the denser carbon of the wood-cellulose."

**475,063.**—Pulp beating and refining machine. Edward R. Marshall, Turner's Falls, Mass.

**475,065.**—Dyeing apparatus. Andrew Reid, Amsterdam, N. Y.

**475,070.**—Melting furnace. Clarence L. Wheeler, Marion, Ind.

**475,122.**—Apparatus for sterilizing milk. Franz Krämer, New York, N. Y.

**475,225.**—Centrifugal machine. Robert D. Weaver, Washington, D. C.

**475,229.**—Art of dyeing wool. James A. Young, Boston, Mass.

**475,255.**—Rheostat. Walter A. Sterling, Denver, Col.

**475,260.**—Method of and apparatus for deoxidizing metals. Montgomery Waddell and Justus B. Entz, New York, and William A. Phillips, Brooklyn, N. Y.

**475,267.**—Brick kiln. Anton Dimpfl, Munich, Ger.

**475,284.**—Crushing mill. Charles E. Philes, Stockton, Cal.

*Issued May 24, 1892.*

**475,330.**—Stone crusher. George Lowry, Northampton, Eng.

**475,335.**—Manufacture of electrodes for secondary batteries. James F. McLaughlin, Philadelphia, Pa.

**475,347.**—Ore crusher. Frank A. Ross, Chicago, Ill.

**475,351.**—Metallurgical furnace. Carl Siemens, St. Petersburg, Russia.

**475,355.**—Welding compound. Hooper B. Straut, Lincoln, Neb.

A composition compounded of borax, one pound; tripoli, one pound; muriate of ammonia, four ounces; prussiate of potash, one ounce; soda ash, five ounces; white sand, five ounces; soft water, one quart.

**475,360.**—Amalgamator. James M. Thompson, San Francisco, Cal.

**475,372.**—Process of developing photographic pictures. Momme Andréén, Berlin, Ger.

**475,381.**—Carbureted-hydrogen-gas generator and burner. John W. Blake and Joseph G. Sackett, Kansas City, Mo.

**475,382.**—Composition of matter and method of producing the same. Craft C. Carroll, New York, N. Y.

An alloy of silver, tin, copper and aluminium.

**475,395.**—Process of recovering grease, etc., from wool washings. Roger B. Griffin, Auburndale, Mass.

**475,398.**—Furnace for iron working. William Heckert, William J. Thomas and Frank L. Heckert, Findlay, Ohio.

**475,402.**—Process of obtaining metallic zinc from zinc sulphite by electrolysis. Theodor Lange, Brieg, Ger.

**475,418.**—Compound for cleaning and scouring. Chas. H. Peterson and Orlando C. Ruge, St. Louis, Mo.

A compound containing "water, aqua ammonia, alcohol, sulphuric acid, glycerine, cocoanut oil soap and quillaia bark."

**475,433.**—Brick kiln. Max A. T. Boehncke, Centinela, Cal.

**475,437.**—Extracting perfumes. Robert A. Chesebrough, New York, N. Y.

**475,454.**—Coated metal pipe and method of manufacturing the same. William Lacy, Jr., Los Angeles, Cal.

**475,471.**—Pulverizing machine. Axel Sahlin, New Brighton, N. Y.

**475,478.**—Hydro-carbon oil burner for furnaces. John Wilson, New York, N. Y.

**475,483.**—Clay reducer. Walfrid Burkman, San Francisco, Cal.

**475,498.**—Process for rendering iron, steel and other similar metals homogeneous. Joseph C. Fraley, Philadelphia, Pa.

**475,513.**—Temperature regulator. James F. McElroy, Albany, N. Y.

**475,522.**—Apparatus for separating matter from slag. Dennis Sheedy, Denver, Col.



475,528. } Rheostat. Charles Willms, Baltimore, Md.  
475,529. }

475,540.—Apparatus for discharging gas-retorts. André Coze, Paris, France.

475,547.—Deodorizing device. Edward O. Ely, Boston, Mass.

475,548.—Beer cooler. William W. Ferguson, Bloomdale, Ohio.

475,551.—Process of ungumming and decorticating textile material. Charles Girard, Paris, France.

The fibers are first treated with potassium manganate, then washed and treated to a bath of sulphurous acid and again washed.

475,557.—Ore sampling device. Robert C. Hawley, Pueblo, Col.

475,558.—Process of treating matter and ores. Henri L. Herrenschmidt, Petit Querilly, France.

475,574.—Apparatus for manufacturing salt. Charles F. Lawton, Arthur W. Lawton and Albert L. Lawton, Rochester, N. Y.

475,575.—Apparatus for the manufacture of salt. Charles F. Lawton, Arthur W. Lawton and Albert L. Lawton, Rochester, N. Y.

475,576.—Process of manufacturing salt. Charles F. Lawton, Arthur W. Lawton and Albert L. Lawton, Rochester, N. Y.

475,577.—Salt. Charles F. Lawton, Arthur W. Lawton and Albert L. Lawton, Rochester, N. Y.

475,586.—Process of solidifying liquid acids. Philip Mauro, Washington, D. C.

475,587.—Diffusion battery. George A. Mersick, Wilmington, Del.

475,602.—Apparatus for drying spent grain and the like. Friederich E. Otto, Dortmund, Germany.

475,609.—Copper smelting furnace. Benjamin Richards, Middle Bank, Swansea, Eng.

475,616.—Induline dye. Robert Senger, New York, N. Y.

Prepared by mixing one molecule of induline with three molecules of oleic acid, and then heating the mixture to about 100° to 120° centigrade. An intensely black liquid of the consistency of castor oil, insol. in water, soluble in alcohol and benzine.

475,637.—Apparatus for evaporating brine. Theodore R. Timby, Washington, D. C.

475,670.—Process of purifying sewage. Francis R. Conder, Guilford, England.

475,718.—Compound for waterproofing. James Stewart, Philadelphia, Pa.

475,725.—Process of tempering and hardening metals. Joseph S. Durning, Emsworth, Pa.

475,728.—Apparatus for charging machines with liquified gas. Paul Gifford, Paris, France.

**475,737.**—Chemical compound for treating tobacco. George S. Yingling, Tiffin, Ohio.

The compound consists of gallic acid, tannic acid, extract of geranium and extract of licorice.

*Issued May 31, 1892.*

**475,757.**—Process of recovering glycerine and salt from spent soap lye. Albert Dorneier and Otto C. Hagemann, London, Eng.

**475,758.**—Process of recovering crude glycerine from spent soap lye. Albert Dorneier and Otto Hagemann, London, Eng.

**475,774.**—Apparatus for conducting and screening gases from metallurgical furnaces. Malvern W. Iles, Denver, Col.

**475,779.**—Grain separator. James M. King, Rochester, Minn.

**475,784.**—Apparatus for boiling soap. Joel W. Martin, Hartford, Conn.

**475,794.**—Machine for decorticating fiber-bearing plants. John Von Oven and Charles F. Pankinn, Charleston, S. C.

**475,795.**—Apparatus for condensing steam. William E. Prall, Washington, D. C.

**475,797.**—Secondary battery electrode and process of making the same. Anthony Reckenzanne, London, Eng.

**475,819.**—Flax and hemp brake. John T. Smith, Heron Lake, Minn.

**475,824.**—Process of roasting ores. Charles W. Stickney, Butte City, Mont.

The process "consists in injecting steam at a red or higher heat into a furnace containing ore, whereby sulphuretted hydrogen is generated, and roasting another portion of ore by means of air, whereby sulphurous acid gas is generated, and mingling these gases in contact with water holding clay in suspension, whereby sulphate of alumina is generated and its solution mingled with the gases."

**475,853.**—Process of manufacturing beer. Christian Feigenspan, Newark, N. J.

**475,856.**—Fruit press. Samuel Grossman, Chicago, Ill.

**475,876.**—Automatic smoke consuming furnace. Michael J. Lynn, Rochester, N. Y.

**475,897.**—Fireworks. Carl Schmidt, Berlin, Germany.

A composition for star fireworks, consisting of steel chips, charcoal, nitrate of lead, shellac and spirits.

**475,898.**—Rheostat. Frederick W. G. Schneider, Toronto, Canada.

**475,907.**—Process of refining silver sulphides. William G. Waring, Silver City, N. Mex.

**475,915.**—Process of preparing clay. Phineas Arnold, Canal Dover, Ohio.

**475,961.**—Rectifying apparatus. Bogdan Hoff. Jaroslan and Julius Frommel, Parolosian, Austria-Hungary.

**475,972.**—Carburetor. ' Edgar R. Badlam, San Francisco, Cal.

**476,085.**—Apparatus for cleaning and concentrating ores. William Clancy, Anaconda, Mont.

**476,073.**—Still and process. Philip Rodes, Greenfield, Va.

**476,091.**—Process of purifying metals. Benjamin Talbot, Chattanooga, Tenn.

**476,092.**—Process of refining metals. Benjamin Talbot, Chattanooga, Tenn.

**476,093.**—Tester for spirituous liquors. Kemmer Taylor, Frankfort, Ky.

**476,095.**—Apparatus for calibrating water meters. John Thompson, Brooklyn, N. Y.

**476,096. 476,097, )** Proportional water meters. John Thompson, Brook-

**476,099, 476,100. )** lyn, N. Y.

**476,098.**—Method of and apparatus for maintaining a proportional flow of fluids through separate chambers. John Thompson, Brooklyn, N. Y.

**476,103.**—Positive proportional meter.

**476,104.**—Proportional water meter.

**476,102.**—Disk water meter.

{ John Thompson,  
Brooklyn, N. Y.

**476,160. )** Machines for testing fibrous plants. James L. Myers, New

**476,161. )** Orleans, La.

**476,166.**—Dry Closet. Willis D. Over, Bryan, Ohio.

**476,177.**—Hydrocarbon burner. Edward J. Thompson, Antrim, N. H.

**476,231.**—Purifier and separator. Jonathan Mills, Columbus, Ohio.

J. F. G.

REGULAR MEETING, JUNE 3, 1892.

The meeting was called to order at 8:30 P. M. in the Law Lecture Room of the University. Prof. A. A. Breneman in the chair.

The committee appointed to draw up resolutions in regard to the death of Dr. A. W. von Hofmann reported that they had prepared the following :

*“ Whereas, The American Chemical Society on the 6th of May, 1892, received the melancholy news of the death of its Honorary Member Dr. August Wilhelm von Hofmann, Professor of Chemistry in the University of Berlin, and President of the German Chemical Society, therefore*

*Resolved, That we deeply deplore the loss of our honored member, one of the most distinguished men of science, whose services to chemistry as an investigator of most difficult problems, as a lucid expounder of the truth, and as a leader in scientific thought, will ever be recalled with gratitude. That in America especially he will long be remembered as an earnest and devoted teacher, and one who endeared himself to pupils of every nationality. That, to the German Chemical Society in particular, we offer our sincere condolence at the loss it has sustained in the removal of its founder, who, by his earnest leadership and wise counsels contributed so largely toward its present great and well deserved prosperity.*

(Signed) G. C. CALDWELL,  
President.

DURAND WOODMAN,  
Recording Secretary.

It was moved and seconded that the report of the committee be adopted, and that the committee be discharged.

It was also ordered that an engrossed copy of the resolution be sent to the German Chemical Society.

The following members were elected :

Dr. J. E. Blomeis, Landing, N. J.

Prof. Walter S. Haines, M. D., Rush Med. Coll., Chicago, Ill.

Dr. Wm. M. Mew, Washington, D. C.

Mr. Wm. H. Seaman, 1424 11th street, Washington, D. C.

Ernest Speidel, B. Sc., 19 Quincy street, Chicago, Ill.

Mr. W. M. Stiles, foot 39th street, Brooklyn, N. Y.

Dr. H. T. Vultè, School of Mines, N. Y.

Dr. Frederic Zinsser, 501 West 58th street, N. Y.

The following nominations were made:

Dr. Henry Carmichael, 12 P. O. Square, Boston, Mass.

Prof. Edward T. Fristoe, Columbian Univ., Washington, D. C.

Prof. N. F. Merrill, Burlington, Vt.

Dr. E. A. de Schweinitz, Cosmos Club, Washington, D. C.

Mr. Geo. Steiger, 1303 F street, Washington, D. C.

A paper on "Observations on American Menthols," by Prof. J. H. Long, of Chicago, was read by title, and announced for publication in the Journal.

The meeting was then adjourned.

DURAND WOODMAN,  
Recording Secretary.

## THE NEW YORK SECTION.

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The regular meeting of the Section was held at the close of the June meeting of the Society. Prof. A. H. Sabin in the chair.

A committee consisting of Dr. H. C. Bolton, Prof. Elwyn Waller and Prof. A. A. Breneman was appointed by the chair to represent the Section in the New York Scientific Alliance, a local association of Scientific Societies.

## OBSERVATIONS ON AMERICAN MENTHOL.

By J. H. LONG.

As is well known, the menthol from the American oil of pepperment differs much in its physical appearance from that obtained from the English or Japanese oil. The common Japanese menthol appears in commerce in the form of small prismatic crystals, while the American products appear as long, slender needles. This difference is evidently not accidental, depending on the method of distillation and purification followed by the different producers, as it is observed in the products which have been recrystallized by the same person under the same general conditions. A distinct difference in the odor of the two products may also be noted, even after several crystallizations and distillation in vacuo.

The American menthol is produced chiefly from the oil distilled in New York and Michigan, but owing to its relatively high cost is not commonly found in the market at the present time.

A grade of very great purity is produced by the well known distiller of essential oils, Albert M. Todd, Esq., of Nottawa, Mich., to whom I am indebted for samples used in this investigation.

The peculiarities of this menthol were explained in the *American Journal of Pharmacy* for June, 1884, and the name *pimenthol* then suggested. A fuller description of the product was given by Prof. Henry Trimble in the August, 1884, number of the same journal.

To obtain the menthol from the oil the latter is placed in a vessel with double walls, the space between being packed with a mixture of ice and salt. After a time crystallization takes place, from 20 to 40 per cent. of the menthol present separating out. The solvent oil is then allowed to drain out through a tube leading from the bottom of the inner vessel. By exposure to the air the crystals soon dry and are practically pure, as shown by tests of numerous samples made at different times. From oil very rich in the

camphor crystals separate out at a temperature near 0° C. A specimen secured in this way was dried by simply passing between folds of filter paper when it was found to be nearly pure.

In a preliminary examination of a number of samples obtained from several sources, solutions were made by dissolving 10 grms. of the commercial product in alcohol of 95 per cent. strength and making up to 100 cc. These solutions were polarized in a 300 mm. tube of the large Landolt apparatus with the following result:

No.	$a_D$
1	—14.805.
2	—14.741.
3	—14.745.
4	—14.660.
5	—14.690.
6	—14.760.

Samples 4 and 5 were quite moist. After drying higher results were obtained, each showing

$$a_D = -14.73.$$

From this it appears that the commercial product is nearly constant in composition, if the polarization can be taken as a criterion.

I had at my disposal a large amount of sample No. 6, which was purified as follows:

About 500 grms. was melted and poured into warm water in a beaker on a water bath. The two liquids were repeatedly mixed by stirring and kept at a temperature of 60–70° C half an hour. In this way a slight amount of some insoluble body was separated from the menthol, and collected at the bottom of the beaker. The menthol layer was then poured off and allowed to stand until it crystallized, the crystals being afterwards dried between porous plates in the air. An attempt was made to distil these dried crystals under the ordinary atmospheric pressure, but without perfect success, as a slight decomposition took place. This was indicated by a change of color in the boiling liquid, it becoming yellowish brown, and also by a lowered rotation in the distillate. A solution of 10 grms. made to 100 cc. with alcohol, as before, gave now

$$a_D = -14.51.$$

However, distilling under reduced pressure gave a much better result. Some specimens were distilled several times under a pressure of 50–100 mm. and when polarized under the same conditions as before gave uniformly  $a_D = -14.820$ .

The whole sample was purified in this way and used for a number of experiments chiefly in the line of polarization phenomena.

#### DENSITY, MELTING POINT AND BOILING POINT.

The density of the solid menthol in compact form was found by weighing in water to be

$$d \frac{20}{4} = .890.$$

This is the value given by Moriya (Jour. Chem. Soc. xxxix, 77) for the crystals at  $15^\circ$ .

For the density of the melted menthol I find

$$d \frac{44.6}{4} = .8810,$$

which is somewhat higher than the value given by Gladstone and Dale for the Japanese. My own determination for the Japanese is

$$d \frac{47}{4} = .878.$$

The melting point of the distilled American menthol I find as  $42.3^\circ$ , while that of the single Japanese sample was a trifle higher, viz:  $42.6^\circ$ . These are somewhat higher than the values usually given, which were probably obtained from the undistilled product. With crystals dried in the air or between paper I find lower values. Moriya (loc. cit.) gives  $39^\circ$ , Atkinson & Yoshida (Jour. Chem. Soc. xli, 50) give low values for the air dried crystals, but find  $42.2^\circ$  as the melting point of a sample purified by distillation. The boiling point of the distilled American menthol I find to be  $212.5^\circ$  (corr.) with Bar. = 742. The values given by various observers for the Japanese range between  $210^\circ$  and  $213^\circ$ .

#### SPECIFIC ROTATION.

I find nothing in the literature on the specific rotation of the liquid (melted) menthol. Some results are found for the Japanese



menthol based on an examination of alcoholic solutions, but the date seems to be, in several instances, inaccurate. The value given by Oppenheim (*Jour. Chem. Soc.* xv, 26) is

$$[\alpha]_D = -59.^\circ 6,$$

deduced from a 10 per cent. solution in alcohol. Moriya (*loc. cit.*) gives

$$[\alpha]_D = -59.^\circ 3$$

which corresponds approximately to

$$[\alpha]_D = -49.^\circ 4$$

for a 10 per cent. solution.

For a 10 per cent. alcoholic solution, Arth (*Ann. de Chim. et de Phys.* [6], vii, 438) gives

$$[\alpha]_D = -50.^\circ 1,$$

while for one of 5 per cent. he gives

$$[\alpha]_D = -49.^\circ 4.$$

I have made a direct determination of the rotation in a sample of the melted American menthol. A 200 mm. jacketed tube was employed and a temperature of  $46^\circ$  was maintained during the time of the experiment by means of a current of warm water. This temperature is high enough to keep the substance in a state of perfect fluidity, and is the temperature at which the specific gravity was found.

The mean of a number of closely agreeing readings was

$$\alpha_D = -87.^\circ 716,$$

and this gives, after introducing a slight correction for length of tube at the higher temperature,

$$[\alpha]_D = -49.^\circ 86.$$

To determine how this value agrees with those deduced from the rotation of solutions was the object of a lengthy series of experiments, the main details of which are here given. Solutions were made in alcohol, benzene and glacial acetic acid, the menthol used being all taken from the same distilled sample.

#### SOLUTIONS IN ALCOHOL.

For these tests a pure redistilled alcohol of approximately 95 vol. per cent. was used. This was taken in preference to absolute alcohol where change of strength by exposure to air is unavoidable.

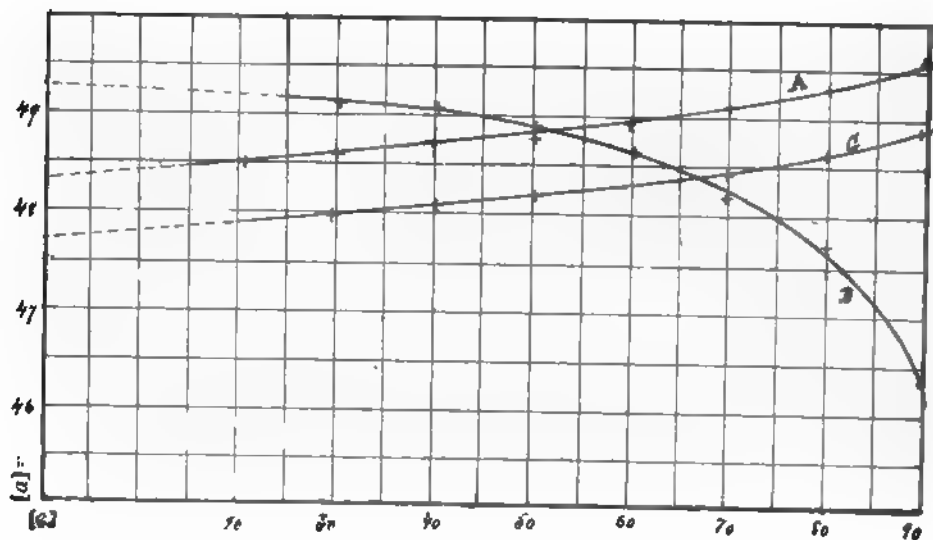
The actual strength of the alcohol employed in all the tests is given by the specific gravity,

$$d \frac{20}{4} = .81441.$$

Eight solutions were made with approximately 10, 20, 30, 40, 50, 60, 70 and 80 per cent. of menthol, all weights being reduced to vacuo. A portion of each solution was used for a specific gravity determination in a small pyknometer, brought always to a temperature of 20° in a vessel of water. This temperature was maintained with an error of less than 0.1 in all the experiments. The remainder of each solution was used for polarization in a 300 mm. tube, kept at 20° by a current of water.

The variation of the length of the tube from 300 is inappreciable, and can be neglected.

The results of the experiments are shown in tabular form, as follows:



No.	Per Cent. of Menthol.	Per Cent. of Alcohol.	Sp. Gr. of Solution.	Observed Rotation, a.
1-----	10.1228	89.8772	.82271	— 12.°385
2-----	20.0126	79.9874	.83010	— 24.°585
3-----	30.0904	69.9096	.83845	— 37.°186
4-----	40.3447	59.6553	.84732	-- 50.°218
5-----	49.8839	50.1161	.85560	— 62.°540
6-----	60.0664	39.9336	.86391	— 75.°856
7-----	69.9443	30.0557	.87401	— 89.°141
8-----	78.9552	21.0448	.88283	— 101.°398

From the observed values of the above table the specific rotations given below were calculated according to the usual formula.

$$[a] = \frac{10^4 a}{l c} = \frac{10^4 a}{l p d}$$

Where  $a$  is the observed angle of rotation,  $l$  the length of tube in millimeters,  $c$  the concentration, or grms. in 100 cc. of solution,  $p$  the percentage strength of the solution and  $d$  its density.

The values of  $[a]$  are not quite constant, but vary slightly with the concentration, decreasing as the latter increases. In other words  $[a]$  increases with  $q$ , expressing by this the percentage amount of the inactive solvent present.

By plotting the values of the specific rotation as ordinates with the amounts of solvent as abscissas we get a curve nearly straight at first but finally slightly concave upward, as shown below in the figure at A.

The deviation from a straight line is so little, however, that the values of  $[a]$  can be very well expressed by the simple interpolation formula:

$$[a] = A + Bq + Cq^2.$$

From solutions 4, 6 and 8 I find

$$[a] = 48.216 + .013237 q - .00001041 q^2.$$

From 6, 7 and 8,

$$[a] = 48.191 + .014974 q - .00003886 q^2.$$

From 3, 6 and 8,

$$[a] = 48.239 + .011510 q + 00001795 q^2.$$

From 2, 5 and 8,

$$[\alpha] = 48.312 + .006840 q. + .00007501 q^2.$$

The mean of the last three is,

$$[\alpha] = 48.247 + .011108 q. + .00001870 q^2.$$

I employed this last equation in the calculation of the values given in the table below, under : "[ $\alpha$ ] cal."

No.	pd. — c.	[ $\alpha$ ] obs.	[ $\alpha$ ] cal.	diff.
1 . . . . .	8.3281	49.°571	49.°396	— .175
2 . . . . .	16.6124	49.°330	49.°255	— .075
3 . . . . .	25.2293	49.°131	49.°115	— .016
4 . . . . .	34.1848	48.°968	48.°976	+ .008
5 . . . . .	42.6807	48.°843	48.°851	+ .008
6 . . . . .	51.8920	48.°727	48.°720	— .007
7 . . . . .	61.1320	48.°606	48.°598	— .008
8 . . . . .	69.7040	48.°489	48.°488	— .001

The calculated and observed values agree very closely except for the two most dilute solutions, where the specific rotations by observation is higher.

In Arth's experiments, referred to above, the strength of the alcohol is not given, nor is the density of his solutions, but it is evident that the value for the 10 per cent. solution is too high. This value is inconsistent when taken in connection with that of the 5 per cent. solution.

From the above observations it is seen that the specific rotation of the pure substance, as deduced from tests of solutions, must be about 48.°25 at 20°. In order to compare this value with that obtained by observations on the melted menthol I polarized solutions at higher temperatures. One such solution contained 17.37 per cent. of menthol and had the specific gravity :

$$d_{40} = .798.$$

In the 200 mm. tube it gave  $\alpha = -21.°05$ , from which

$$[\alpha] = -50.°62.$$

That is, the specific rotation increases with the temperature. Assuming that the increase is approximately the same for all concentrations the specific rotation deduced from strong solutions at

this temperature should be about  $-49.^{\circ}5$ . This agrees satisfactorily with the observed value  $-49.^{\circ}89$ .

#### SOLUTIONS IN BENZENE.

Several tests were made with pure recrystallized benzene as a menstruum, in which the menthol is very readily soluble. The chief results of these experiments are given in this table :

No.	Per Cent. of Menthol.	Per Cent. of Benzene.	Sp. Gr. of Solution.	Observed Rotation, a.
9-----	10.0326	89.9674	.88016	$-12.^{\circ}282$
10-----	20.0163	79.9837	.88131	$-25.^{\circ}265$
11-----	30.4343	69.5657	.88276	$-38.^{\circ}928$
12-----	39.8777	60.1223	.88435	$-51.^{\circ}437$
13-----	49.3899	50.6101	.88575	$-64.^{\circ}206$
14-----	59.8799	40.1201	.88778	$-78.^{\circ}300$
15-----	69.6514	30.3486	.89025	$-91.^{\circ}510$

Calculating the specific rotations from the above observations and plotting them as functions of the dilution,  $q$ , we obtain a curve which deviates greatly from a straight line. The deviation at the points corresponding to weak solutions is so great that a simple interpolation formula will not satisfy the whole curve.

For the stronger solutions this equation gives results which can be used :

$$[a] = 49.^{\circ}511 - .025634 q. + .0008403 q^2. \\ - .00001102 q^3.$$

Nearly the same constant is given by the equation :

$$[a] = 49.^{\circ}495 - \frac{28.614 q.}{2836.8 + q.}$$

The true specific rotation of the menthol as found from the benzene solutions appears, therefore, to be higher than that found from the solutions in alcohol. The specific rotation of the melted menthol lies between that deduced from the benzene and alcohol solutions.

Owing to the greater volatility of the benzene it is probable that the rotations observed are a trifle high because of a slight loss of the menstruum by evaporation, even when great care was taken in the manipulation.

The values of the specific rotation are given in the following table, while the plotted curve, showing variations in some, is given at B in the figure.

No.	pd. — c.	[ $\alpha$ ] obs.	[ $\alpha$ ] cal.	diff.
9.....	8.8303	46.°366		
10.....	17.6405	47.°741		
11.....	26.8662	48.°299	48.°085	— .214
12.....	35.2658	48.°619	48.°613	— .006
13.....	43.7472	48.°922	48.°940	+ .018
14.....	53.1602	49.°097	49.°125	+ .028
15.....	62.0071	49.°193	49.°199	+ .006

## SOLUTIONS IN ACETIC ACID.

A third series of experiments was carried out, using pure recrystallized acetic acid as the solvent.

The solutions were made in all cases without the application of heat and were not allowed to go above 22°. The table below gives the results of the individual tests :

No.	Per Cent. of Menthol.	Per Cent. of Acid.	Sp. Gr. of Solution.	Observed Rotation, a.
16.....	10.2488	89.7512	1.03099	— 15.°482
17.....	20.1108	79.8892	1.01298	— 29.°744
18.....	30.1956	69.8044	.99615	— 43.°739
19.....	40.4986	59.5014	.98010	— 57.°559
20.....	49.5124	50.4876	.96606	— 69.°201
21.....	59.8591	40.1409	.95161	— 82.°164
22.....	70.0220	29.9780	.93757	— 94.°454

The results of the calculated specific rotations, when plotted as before, give a very regular curve resembling that found from the alcohol solution. This curve is shown at C in the figure.

The points on this curve are given by equations as follows :

From 20, 21 and 22,

$$[a] = 47.663 + .007638 q. + .00006929 q^2.$$

From 17, 20 and 22,

$$[a] = 47.615 + .010226 q. + .00003712 q^2.$$

From 16, 18 and 21,

$$[a] = 47.856 + .001293 q. + + .00010784 q^2.$$

The mean of these gives,

$$[a] = 47.711 + .006386 q. + .00007142 q^2.$$

from which the calculated specific rotations in the table below were found. These agree very well with the results of direct experiment :

No.	pd. — c.	[a] obs.	[a] cal.	diff.
16.....	10.5665	48.°840	48.°859	+ .019
17.....	20.3718	48.°668	48.°676	+ .008
18.....	30.0792	48.°471	48.°505	+ .034
19.....	39.6928	48.°338	48.°343	+ .005
20.....	47.8320	48.°225	48.°215	— .010
21.....	56.9625	48.°081	48.°082	+ .001
22.....	65.6506	47.°954	47.°966	+ .012

It is apparent that acetic acid is not a good menstruum in this case, although the values given are very regular. The specific rotation in the concentrated solutions falls below that observed with the liquid menthol. At high temperatures menthol and acetic acid act on each other with production of acetate, and it is possible that some of the same product is formed at a temperature of 20° even.

But Oppenheim has shown (loc. cit.) that the acetate has a much higher specific rotation than the original menthol, which result I have confirmed by recent experiments. However, with the ether formed at the ordinary temperature I should have found a higher rather than a lower specific rotation with the solutions experimented on. An observation having some bearing on the question was made during the tests in this manner. Several solu-

tions, first polarized immediately after preparation, were kept ten days in well stoppered bottles and polarized again. In the second test a higher result was always found, which would correspond to the behavior of ether produced in the interval.

Apparently, the first effect of the acid with the menthol is to produce a combination characterized by slightly lower specific rotation, which later gives place to the ether with higher than normal rotation.

Several experiments were tried with a single sample of Japanese menthol dissolved in alcohol and acetic acid. The results found were slightly higher than those obtained from any one of the American samples. This Japanese product was clean and dry and apparently a pure commercial specimen. I redistilled it under low pressure and used this product for the test:

In the 300 mm. tube it gave,

$$a = -14.840$$

for a solution containing exactly 10 grms. in 100 cc., the same alcohol employed in the other test being used here.

The purified American sample gave under the same conditions,

$$a = -14.820.$$

The slight differences in physical properties between the two varieties of menthol are not important enough to point to a difference in chemical structure. It is possible that they may be due to the presence of traces of associated products in the original oil which cannot be perfectly separated by the simple methods employed in purification. It appears from the investigations of Beckett and Wright (*Jour. Chem. Soc.*, XXIX., 1) and Trimble (*loc. cit.*) that the oil of peppermint contains, besides menthol, another oxidized product in small amount, probably menthone. This is a body with high boiling point, only slightly lower than that of menthol and + rotation. A trace of it could easily remain with the menthol and exert an appreciable influence on the specific rotation, sufficient, probably, to account for the trifling differences noted above.

CHICAGO, May, 1892.



## Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

Issued June 7, 1892.

- 476,247.**—Food steamer. Thomas Cassaden, Jr., Waterloo, Iowa.
- 476,256.**—Method of and apparatus for extracting aluminium. Michael Emme, Atlanta, Ga.
- 476,260.**—Gas or steam generator. Jacob M. Goldsmith, Chicago, Ill.
- 476,261.**—Gas generator. Jacob M. Goldsmith, Chicago, Ill.
- 476,264.**—Magnesium light composition. Eugen Hackh, Stuttgart, Ger.
- 476,274.**—Apparatus for purifying, moistening and attemperating air. Louis C. Huck, Chicago, Ill.
- 476,276.**—Disinfectant. Henry Jackson, Chicago, Ill.  
Consists of slaked lime, sulphate of iron, crude carbolic acid, caustic soda, sodium chloride.
- 476,286.**—Apparatus for skein dyeing. Alvin S. Lyon, Lowell, Mass.
- 476,320.**—Paste making machine. Francis H. Shepherd, Davenport, Iowa.
- 476,335.**—Violet azo dye. Moritz Ulrich, Elberfeld, Ger.
- 476,336.**—Black azo dye. Moritz Ulrich, Elberfeld, Ger.
- 476,337.**—Blue dye. Moritz Ulrich, Elberfeld, Ger.
- 476,371.**—Tetrazo blue dye. Carl Dinsberg, Elberfeld, Ger.
- 476,372.**—Thermostatic governor and moter. William E. Eastman, Boston, Mass.
- 476,374.**—Recording thermometer. William E. Eastman, Boston, Mass.
- 476,393.**—Dyestuff. Richard Lauch, Elberfeld, Ger.  
Process for producing a dyestuff by combining "molecular proportions of tetrazo-diphenyl, salicylic acid, and alpha-naphthylamine, sulphonating the product thus obtained, diazotizing and further combining it with one molecular proportion of the sodium salt of alpha-naphthol-alpha-monosulphonic acid."  
A greenish black amorphous powder, readily sol. in water with deep gray black color, in soda lye with red, and in concentrated sulphuric acid with intensely blue-red color, which latter turns greenish blue on addition of a large quantity of water. It dyes unmordanted cotton in neutral or alkaline baths a greenish black or dark gray of high fastness and intensity.
- 476,413.**—Triphenylmethane dye. Friederich Runkel, Elberfeld, Ger.

**476,414.**—Triphenylmethane dye. Friederich Runkel, Elberfeld, Ger.

**476,418.**—Alizarine derivative. Robert E. Schmidt, Elberfeld, Ger.

Alizarine bordeaux is oxidized with manganese in concentrated sulphuric acid solution and the resulting diquinone then combined with salicylic acid in sulphuric acid solution. A greenish black amorphous mass with metallic luster, almost insol. in cold and hot water, sol. in sod. carbonate with reddish blue color and very soluble in soda lye with greenish blue color, in ammonia with pure blue color in conc. sulphuric acid with greenish blue color from which solution water precipitates yellowish brown flakes. It dyes wool mordanted with chromium salts in greenish blue shade.

**476,419.**—Alizarine dye. Robert E. Schmidt, Elberfeld, Ger.

A new dyestuff produced by the action of ammonia upon the anthradiquinone formed when alizarine bordeaux is oxidized in sulphuric acid solution with manganese at low temperatures.

It is almost insol. in water, but soluble in solutions of sod. carbonate with reddish violet, in soda lye with indigo blue color, in ammonia liquid with bluish violet color, by conc. sulphuric acid with dark violet color which turns at first into red and then into reddish brown when diluted with water.

**476,420.**—Alizarine derivative. Robert E. Schmidt, Elberfeld, Ger.

Alizarine bordeaux is treated with ammonia and subsequently precipitated with acids. A dark violet crystalline compound with greenish reflex, insol. in water, soluble in soda lye with bright blue color, in concentrated sulphuric acid with red color and cinnabar-red fluorescence separating on the addition of water in yellowish brown flakes. The sulphuric acid solution shows distinct and clear bands of absorption in the spectroscope. It dyes wool mordanted with chromium salts a blue color.

**476,441.**—Centrifugal apparatus for cooling or heating liquids. Carl G. Bjorlin, Stockholm, Sweden.

**476,447.**—Apparatus for making ultramarine blue. Johann Büttel, Newark, N. J.

**476,483.**—Secondary battery plate. Edward C. Paramore, Philadelphia, Pa.

**476,491.**—Alizarine dye. Robert E. Schmidt, Elberfeld, Ger.

Alizarine bordeaux in sulphuric acid solution is oxidized with manganese and the resulting anthradiquinone treated with salicylic and subsequently with ammonia.

An olive colored powder with metallic luster, sparingly sol. in water, easily soluble in sod. carbonate with blue color, in soda lye with greenish blue and in ammonia, glacial acetic acid, or alcohol with reddish blue color, in conc. sulphuric acid with reddish violet color, from which solution water precipitates reddish brown flakes. Wool mordanted with chromium salts is dyed a clear bluish green.

- 476,497.—Amalgamator. Alva M. Stetson, Oakland, Cal.  
 476,500.—Concentrator. James Tulloch, Angels Camp, Cal.  
 476,542.—Artificial stone. Johann H. Kleb, Newark, N. J.  
 476,548.—Depurator. John Nixon, Farmland, Ind.  
 476,554.—Apparatus for converting petroleum, etc., into gas and burning the same. George F. Randolph, Little Genesee, N. Y.  
 476,555.—Manufacture of soap with whey. Albert W. Rehnström, Mülhammar, Sweden.  
 476,556.—Manufacture of soap. Albert W. Rehnström, Mülhammar, Sweden.  
 476,557.—Soap. Albert W. Rehnström, Mülhammar, Sweden.  
 476,560.—Apparatus for burning petroleum oils, etc. Oswald R. Ruth, Jersey City, N. J.  
 476,574.—Lubricant. Wilson H. Strickler, Dodge City, Kan.  
 476,580.—Apparatus for dyeing. George M. Undy, Philadelphia, Pa.  
 476,592.—Process of making borax. Jesse Ascough, Handsworth, Eng.  
 A process for granulating borax.  
 476,599.—Process of and apparatus for the manufacture of alimentary products from corn. Hervey Bates, Jr., Indianapolis, Ind.  
 476,611.—Steam generator. James Cunningham, Dushore, Pa.  
 476,645.—Method of and apparatus for aerating beverages. William Hucks, London, Eng.  
 476,651.—Apparatus for galvanizing wrought or cast iron and steel. Thomas Jones, Netherton, Eng.  
 476,671.—Beer filter. Johan Moeller, Boston, Mass.  
 476,672.—Glass furnace. Michael E. Murphy, Coraopolis, Pa.  
 476,701.—Evaporating pan. Harrison F. Thurston, Centre Bartlett, N. H.  
 476,709.—Carburetor and purifier. George W. Weaver, Greensburg, Pa.  
 476,733.—Galvanic battery. Martin M. Clark, Chicago, Ill.  
 476,737.—Filter. William M. Deutsch, Elizabeth, N. J.

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- 476,775.—Hot air furnace. Henry D. Babcock, Leonardsville, N. Y.  
 476,788.—Composition for cleaning wall paper and for other purposes. James E. Devine, Baltimore, Md.  
 A composition consisting of flour, sodium chloride, powdered naphthaline and coloring matter.  
 476,789.—Furnace for smelting zinc ores. Selwyn C. Edgar, St. Louis, Mo.  
 476,832.—Apparatus for making ice. Thomas Shipley, Cincinnati, Ohio.  
 476,837.—Evaporator. Elias Stillwell, Dadeville, Mo.  
 476,877.—Hot air furnace. Jacob Fridley, Carlisle, Pa.  
 476,891.—Process of and apparatus for evaporating sugar solutions. James A. Morrell, New Orleans, La.

**476,896.**—Soldering metal for aluminium. Alexis Rådes, Christiana, Norway.

An alloy of zinc, cadmium and tin.

**476,913.**—Process of manufacturing an alloy of iron or steel and nickel. Ezra F. Wood, Munhall, Pittsburgh, Pa.

A layer of limestone is charged into a basic furnace, "superimposing a layer of bricks composed of nickel oxide and carbonaceous material, then charging in pig iron and heating the charge, thereby causing reduction of the oxide and decarburization of the iron and producing an alloy of nickel and steel."

**476,914.**—Process of and apparatus for the extraction of aluminium. Myrthil Bernard and Ernest Bernard, Paris, France.

An electrolytic process. Cryolite and sodium chloride are melted together "in such proportions as to form a bath which is specifically lighter than aluminium and then passing the main portion of an electric current through the bath between an anode and a cathode to the exclusion of the containing vessel and the remaining fraction of the current through the bath between the anode and the containing vessel as a fractional cathode, whereby pure aluminium is liberated at the cathode and aluminium alloy is formed upon the containing vessel."

**476,917.**—Confectioners' kettle. Thomas Burkhard, Brooklyn, N. Y.

**476,930.**—Distilling and rectifying apparatus. Jean Schafhaus, New York, N. Y.

**476,934.**—Fluid meter. Emanuel Spin. Kruman, Austria-Hungary.

**476,955.**—Amalgamator. William J. Gard, Samuel S. Dalzell and William A. Shafer, Moab, Utah.

**476,979.**—Centrifugal apparatus. Charles L. Cairns, Jersey City, N. J.

**476,983.**—Pyromagnetic generator. Thomas A. Edison, Llewellyn Park, N. J.

**476,991.**—Method of and apparatus for separating ores. Thomas A. Edison, Llewellyn Park, N. J.

**477,023.**—Apparatus for melting tallow, wax, etc. August Seiffert, Frankenstein, Ger.

**477,026.**—Apparatus for treating ores. William H. B. Stout, Chicago, Ill.

**477,061.**—Apparatus for purifying oil. Emil Noppel, Philadelphia, Pa.

**477,063.**—Churn. Daniel H. Parker, Pleasantville, Pa.

**477,072.**—Measuring funnel. Thomas F. Scollay, Memphis, Tenn.

**477,089.**—Process of purifying ammonia. Hans von Strombeck, New York, N. Y.

The crude ammonia gas is exposed to the action of metallic sodium, the gas purified, separated from the impurities and finally liquified.

**477,111.**—Concentrator. George Gates, Jackson, Cal.

**477,121.**—Automatic temperature regulating system. Warren S. Johnson, Milwaukee, Wis.

**477,188.**—Process of extinguishing fire. Hiram S. Millis, Detroit, Tex.

**477,148.**—Oven thermometer. Harvey Murdock, Brooklyn, N. Y.

**477,158.**—Distillation of hydrocarbon or other oils. Carl M. Pielsticker, London, Eng.

**477,182.**—Secondary battery. Henry H. Lloyd, Philadelphia, Pa.

*Issued June 21, 1892.*

**477,208.**—Beer filter. Heinrich C. J. Gehake, Berlin, Ger.

**477,218.**—Filter. Omor H. Jewell, Chicago, Ill.

**477,220.**—Process of recovering tin from scrap. John J. Naef, Paterson, N. J.

The process consists in "suspending the scraps in a stannic salt solution containing lead plates, and then passing an electric current from the tin scraps to the lead plates, whereby the tin will be dissolved from the scraps and precipitated on the lead plates."

**477,231.**—Apparatus for casting metals. John J. C. Smith and Victor E. Smith, Passaic, N. J.

**477,238.**—Filter. Claes E. Winterros, Brooklyn, N. Y.

**477,247.**—Rheostat. George K. Cummings, Chicago, Ill.

**477,281.**—Apparatus for purifying oil. Ole K. Thomasen, Christiana, Norway.

**477,286.**—Retort furnace. John A. Yeadon and William Adgie, Leeds, Eng.

**477,313.**—Heat indicator. Frederick W. Sears.

**477,326.**—Method of manufacturing artificial granite and marble. Charles George, Berlin, Ger.

Finely ground silicates are mixed with argilliferous sand, and in special cases with fragments of marble. the mixture melted in a furnace and the bath then mixed with a similar one prepared separately in the same manner and kept in tough state and colored by the addition of metallic oxides, and then casting the resulting mixture in molds.

**477,348.**—Process of recovering tin from scraps and waste tin plate. Camille L. C. Berton, Paris, France.

The process consists in placing the scraps or waste in a bath of a temperature of about 50° C. composed of hydrochloric acid containing 6 per cent. of its weight of a nitrate, then adding more of the scraps or waste in successive charges, and in the meantime gradually raising the temperature of the bath to a point not exceeding 90 C. as it becomes more and more saturated with tin and weaker in the nitrate.

**477,350.**—Process of electroplating with alloys. Edward T. Burrows, Portland, Me.

Wire netting is placed in a solution containing sulphite of copper, caustic potash, zinc sulphate, chloride of tin, sal. ammoniac and muriate of iron and passing a current to it from an anode of copper, tin and zinc.

**477,354.**—Process of and apparatus for generating fuel gas. John W. Culmer, New Brighton, Pa.

**477,357.**—Incrustation preventive. John B. Dodds, Newcastle-on-Tyne, and John R. Fothergill, West Hartlepool, Eng.

A solution of an alkaline zincate is introduced into the boiler.

**477,354.**—Brick kiln. James Henry, Cloverport, Ky.

**477,375.**—Process of making nitric acid. Julius Lang, Griesheim, Ger.

**477,381.**—Air compressor. Arthur O'Brien, Helena, Mont.

**477,418.**—Brick kiln. Michael J. Hynes, Toronto, Canada.

**477,442.**—Evaporator. George M. Newhall and Teile H. Müller, Philadelphia, Pa.

**477,471.**—Condenser. Edward Theisen. Sinzig-on-the-Rhine, Ger.

**477,486.**—Photographic developer. Morume Andresen, Berlin, Ger.

The sensitive plates are treated with paramido-phenol or a derivative thereof.

**477,519.**—Hot air furnace. James Cunningham, Dushore, Pa.

**477,527.**—Apparatus for vaporizing acids in the manufacture of white lead. Edward V. Gardner, London, Eng.

**477,568.**—Method of producing ornamental enamel designs. Frederick B. Nichols and Abbie T. Crane, New York, N. Y.

**477,615.**—Water purifier and boiler cleaner. William V. Walker, Moravia, N. Y.

**477,623.**—Metallurgical furnace. Michael R. Conley, Brooklyn, N. Y.

**477,624.**—Atomizer for liquid fuel. Stephen Cox, Jr., Bridgeton, N. J.

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**477,632.**—Composition of matter for bricks. Ambrose S. Baker, Sandy Creek, N. Y.

A composition of gravel and sand, Portland cement, pulverized iron ore, salt and graphite.

**477,645.**—Battery. William A. Childs, Englewood, N. J.

**477,647.**—Non-conducting covering for steam pipes, etc. Benjamin J. Christie, Leadville, Colo.

**477,670.**—Process of refining raw sugar. Franz O. Matthiessen, Irvington, N. Y.

**477,722.**—Color grinding machine. Hermann J. Weckauf, Rheydt, Germany.

**477,725.**—Apparatus for making gas. Joseph Williams, Jr., and Erasmus O. Peoples, Allegheny, Pa.

**477,727.**—Filtering apparatus. David Williamson, New York, N. Y.

**477,735.**—Process of making white pigments. John Blair, Spokane, Wash.

**477,755.**—Boiling and precipitating tower. Gustav S. Hanisch, Ben-then, Germany.

- 477,759.—Fire indicator. Malvern W. Iles, Denver, Colo.
- 477,792.—Furnace for alloying metals. William A. Baldwin, New York, N. Y.
- 477,794.—Machine for breaking and cleaning hemp. Joseph Breslin, Newport, Ky.
- 477,812.—Sectional surface condenser. Elihu Nelson, New York, N. Y.
- 477,813.—Sectional surface condenser. Elihu Nelson, New York, N. Y.
- 477,814.—Feed water heater and condenser. Elihu Nelson, New York, N. Y.
- 477,815.—Feed water heater and condenser. Elihu Nelson, New York, N. Y.
- 477,816.—Sectional feed water heater. Elihu Nelson, New York, N. Y.
- 477,823.—Method of preparing malt for brewing. Ernst Richter and Adam Schaefer, New York, N. Y.
- 477,834.—Gas retort. André Coze, Rheims, France.
- 477,844.—Preservation of meat. William Laubheimer and Henry Salzer, Baltimore, Md.
- “The process of preserving meat by successive steps of steaming, cooling, compressing while cold, enveloping in a shell of fabric and plaster of paris, and when the latter has hardened placing in a can, with the natural fat of the meat surrounding the package, heating and sealing the can.”
- 477,847.—Manufacture of artificial stone. Wilhelm Reissig, Munich, Germany.
- 477,850.—Art of preserving meat. Henry Salzer, Baltimore, Md.
- “Improvement consisting in surrounding a piece of meat in a shell composed of fabric and plaster of paris, heating in a bath of animal fat, wrapping it in a pliable material impermeable to air and water, and finally subjecting a second time to a sterilizing heat.”
- 477,856.—Fruit evaporator. Joseph W. Doty, Lockport, N. Y.
- 477,859.—Spraying device for cooling beer, etc. Clarence C. Hanford, Medford, Mass.
- 477,872.—Hydrocarbon oil vaporizer and burner. Henry P. Roberts, Jamestown, N. Y.
- 477,875.—Method for arresting and extinguishing combustion in charcoal kilns. Albert Vickers, Baltimore, Md.
- 477,893.—Apparatus for cooling water. Henry B. Ford, Philadelphia, Pa.
- 477,909.—Process of and apparatus for dampening grain preparatory to grinding. Bert Meier and Louis E. Fritsche, Minneapolis, Minn.
- 477,910.—Gas meter. William N. Milsted, New York, N. Y.
- 477,914.—Secondary battery. William L. Silvey, Lima, Ohio.
- 477,934.—Ore concentrator. Horatio F. Hicks, Ashland, Ore.
- 477,936.—Ore concentrator. Edgar A. Hockley, Ouray, Colo.

**477,990.**—Manufacture of stained glass for windows, etc. Arthur R. Carter and Henry C. Hughes, London, Eng.

**477,993.**—Brick kiln. Joseph Conley and James M. Wolfe, Tarkio, Mo.

**477,994.**—Brick kiln. Joseph Conley and James M. Wolfe, Tarkio, Mo.

**478,001.**—Hot air furnace. John N. Frizzell, Brainerd, Minn.

**478,005.**—Violet dye. Robert Guehm and Jacob Schmid, Basle, Switzerland.

**478,039.**—Artificial fuel. Henry Zahn, Denver, Colo.

**478,048.**—Process of purifying water. Coles G. Collins, Kearney, N. J.

**478,051.**—Apparatus for coating tin plates. Albert T. Davies, Morriston, England.

**478,066.**—Washer for paper stock. Walter Moorhouse, Philadelphia, Pa.

**478,067.**—Method of manufacturing ammonium nitrate. Russell S. Penniman, Dover, N. J.

J. F. G.





## FIFTH GENERAL MEETING,

HELD AT ROCHESTER, N. Y., Aug. 16th and 17th, 1892.

### FIRST DAY'S SESSION.

The meeting was called to order at 11:15 A. M., Aug. 16, 1892, in the Lecture Room of the Reynolds' Laboratory of the University of Rochester. Vice-President Prof. A. A. Breneman in the chair.

The Chairman regretted that the President, Prof. G. C. Caldwell of Cornell University could not be present owing to absence in Europe and spoke briefly of the growth and present prospects of the Society; the regular order of business was then taken up.

On motion, reading of the minutes of the June Meeting was omitted.

The following members were elected :

Dr. Henry Carmichael, 12 P. O. Square, Boston.

Prof. E. T. Fristoe, Columbian University, Washington, D. C.

Prof. N. T. Merrill, Burlington, Vt.

Dr. E. A. de Schweinitz, Cosmos Club, Washington, D. C.

Mr. Geo. Steiger, 1303 F street, Washington, D. C.

The following nominations were made :

Prof. L. W. Andrews, State University, Iowa City, Iowa.

Dr. W. N. Bullard, Helena, Montana.

Mr. Halsey Durand, 49 Franklin street, Newark, N. J.

Dr. Samuel H. Griffith, U. S. N., U. S. S. "Jamestown," New London, Conn.

Mr. F. L. Harding, Long Branch, N. J.

Mr. Thos. P. Kingsford, Oswego Starch Factory, Oswego, N. Y.

Mr. James Locke, Am. Glucose Co., Buffalo, N. Y.

Prof. E. G. Smith, Beloit, Wis.

Mr. John B. Stearns, University of Vermont, Burlington, Vt.

The following papers were read :

I. "On some new Nickel Minerals," by Dr. S. H. Emmens; read by the Secretary, in the absence of the author.

II. "A Peculiar Reaction of Niagara River Water," by Edward Gudeman, Ph. D.

III. "On the Use of Fluorides in the Manufacture of Alcohol, by Dr. Leo. Baekeland ; read by the Secretary, in the absence of the author.

IV. Obituary: "Jean Servais Stas," by Prof. Edward W. Morley; read by the Corresponding Secretary, in the absence of the author.

V. "The Estimation of Levulose in Mixtures," by Dr. H. W. Wiley.

The resignation of the Librarian, Dr. C. E. Munsell, was read, and referred to the Board of Directors.

Invitations were read from the Eastman Kodak Co., and the Bausch & Lomb Optical Co., to visit their respective works.

It was moved that the invitation of the Eastman Co. be accepted for three o'clock of Tuesday, August 16th, and the invitation of the Bausch & Lomb Optical Co. for nine o'clock on the following day, and that the Secretary notify the companies of the acceptance of their invitations and of the times appointed.

The Session was then adjourned.

DURAND WOODMAN,

Recording Secretary.

#### SECOND DAY'S SESSION.

The second session of the Fifth General Meeting was called to order at 2:15 P. M., Wednesday, August 17th. The minutes of the first day's session were read and accepted. The Chair called attention to the death of Doctor T. Sterry Hunt, and suggested that a suitable notice of his life and work should be prepared.

It was moved that such a notice be prepared, and that Prof. G. F. Barker be asked to prepare the memorial. Carried.

The Chair asked for a report from the Committee on the World's Congress of Chemists.

Prof. Wm. McMurtrie, chairman of the committee appointed by the Society at the December meeting, reported that the Chicago committee had arranged to work with the committee of the Society as a joint committee, but that no further definite arrangements had been made.

Prof. J. H. Long, of Chicago, by request spoke upon the same subject. He stated that it had been decided to extend invitations to chemists abroad in the joint name of the World's Fair Auxiliary

Committee and of the American Chemical Society; that the Fair Committee agrees to furnish rooms for meetings and to publish the proceedings; also that a list of American and foreign chemists had been prepared to serve as an advisory committee.

Prof. McMurtrie stated that a circular would soon be issued asking for views on the subject from American and foreign chemists.

Prof. W. H. Dudley then moved that the new Constitution as left by the Committee on Revision at their meeting of the preceding day, be read by the Secretary. Carried.

Dr. Wiley then read the draft of the Constitution.

After some discussion it was moved that this meeting recommend to the committee of fifteen on Revision of the Constitution, that each member of the Society be allowed only two votes for member of the Council. Also that the article upon amendments to the Constitution be modified, so as to permit the presentation to the Society of all amendments received by the Council.\* Carried.

Dr. Wiley moved that a committee of three be appointed by the Chair to take measures to amend the charter, so as to remove the section requiring that a majority of the Board of Directors shall be residents of New York. Carried.

The following papers were then read by title:

I. "The Alkaloids of Sabadilla," by Richard Fischer; communicated by Dr. A. B. Prescott.

II. "Note on the Recovery of Arsenic," by Dr. A. B. Prescott.

III. "The Albumenoids of Maize," by Dr. George Archbold.

IV. "Note on the direct oxidation of organic matter in water," by Prof. W. P. Mason.

A vote of thanks was then moved to the University of Rochester and to Prof. Lattimore in particular, for the courtesies and kindnesses extended to the Society. Carried.

A vote of thanks was also given to the Eastman Kodak Company and to the Bausch & Lomb Optical Co.

The meeting was then adjourned.

DURAND WOODMAN, Recording Secretary.

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\* The Committee on Revision of the Constitution, at a meeting held immediately after the close of the general meeting, rejected the first of these recommendations and adopted the second.—ED.



## JEAN SERVAIS STAS.\*

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Born at Louvain, August 21st, 1813. Died at Brussels, December 13th, 1891. .

The magnificent services rendered to science by the great Belgian chemist, were mainly investigations into the foundation in fact of certain speculations as to the unity of matter. They are divided into two groups; one relating to the atomic weights of many elements, the other to the spectra of elements when volatilized. The latter have not yet been published, and are therefore known but imperfectly through brief accounts by friends of Stas. The former have been published; most of them as fully as could be asked. Of them we may well say what Stas said of Berzelius: "His works remain as imperishable monuments of his penetration and genius. His analytical skill has never been surpassed, in fact has never yet been equalled."

The first important work of Stas was an investigation of phloridzine, which had been discovered by him and his friend De Koninck. The existence of this substance had been indicated by Professor Geiger, but it had not been isolated. A fortunate accident put De Koninck in possession of a considerable quantity of the bark of trees containing the new substance, and gave occasion to an investigation, which included the preparation of phloridzine in a pure state, a study of its properties, and a determination of its composition. The share of Stas in this part of the work does not appear from the printed memoirs and abstracts, which were published in the name of the De Koninck; Stas afterwards wrote of it as a joint discovery.

The young physicians of Louvain in these early experiments had good success in determining the properties of their new substance, but their ultimate analysis was less satisfactory. De Koninck afterwards turned his attention to paleontology, though producing a few papers on chemistry. Stas abandoned the practice of the

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\* Elected an honorary member of the American Chemical Society October 2, 1891.

medical profession, for which he had prepared himself, and resolved to follow the inclination towards chemical investigation which he now so strongly felt.

If the year had been 1823 a student of chemistry might have gone to Berzelius. Now, Liebig had been at Giessen since 1824, and Dumas was teaching, in various capacities, at Paris. To Paris Stas went. There was no vacancy in the laboratory of Dumas, and Dumas was too busy even to receive a vain application for admission to it. Stas showed the same unconquerable patience and perseverance here as afterwards in chemical investigation. He went again and again to visit Dumas; finally the servant who opened the door, while again answering "M. Dumas is not at home," by some gesture invited the resolute young man to enter, and showed where to find Dumas. Some weeks later, Stas was a pupil in the laboratory of Dumas, in the company of other students who were afterwards to take honorable places in the ranks of science.

Here Stas continued the investigation of phloridzine. He determined its formula, and the formula of some of its principal derivatives. He found that dilute acids acted upon it to produce glucose and phloretin. Liebig and Woehler had, two years before, noticed a similar reaction in case of amygdalin, and Piria, a fellow student in the laboratory of Dumas, had found that salicin also belonged to the class of compounds now called glucosides. This work on phloridzine formed the subject of an article of forty pages in the *Annales de Chimie et de Physique*, which was translated into the journals conducted by Liebig and by Erdman. Berzelius, in his *Jahresbericht* for 1838, devotes no less than twenty-three pages to an abstract of this paper, being one-eighteenth of the whole space devoted to organic chemistry. The great Swedish chemist, always somewhat chary of praise as he was, remarks, near the close of this abstract, "From a chemist who begins like this, much may be expected."

Under the direction of Dumas, Stas studied the action of alkalis on alcohols. A paper, entitled "*Premier Mémoire sur les Types Chimiques*", appears under the name of Dumas in the *Annales* for 1840; the second memoir appears under the names of Dumas and Stas, and describes the experiments made by the latter. They examined

the reaction in the case of three well characterized alcohols; methyl, ethyl and cetyl alcohols. They found that fusel oil was converted into valeric acid; a fact of considerable interest at a time when but very few compounds occurring in plants and animals had been produced artificially, and of farther interest because it showed that fusel oil contained an alcohol. Valeric acid was thoroughly studied, its vapor density determined; some of its salts and some of its substitution products prepared and analyzed, and the new product was shown to be identical with the acid of the *Valeriana officinalis*, L. They converted the supposed alcohol into valeraldehyde, and also studied the action of a mixture of potassa and lime on many ethers.

Dumas and Stas now began an investigation which was of great importance in itself and still more important in that it may almost be said to have given direction to nearly all the subsequent course of Stas. In 1838 Dumas had expressed the conviction that the atomic weight of carbon then accepted was in error. The amount of the error he then supposed might be about six parts in one thousand. The reason for this opinion was the fact that, in the ultimate analysis of hydrocarbons rich in carbon, the sum of the amounts of carbon and hydrogen computed from the results of the analysis was greater than the weight of substance taken for analysis. For instance, in three series of analyses of naphthalene, Dumas found an excess of seven parts in one thousand, and Liebig made a similar observation. Berzelius had first computed the atomic weight of carbon from the density of carbon dioxide as determined by Biot and Arago; from which resulted the number 75.33 ( $O=100$ .) He saw reason to doubt the accuracy of this density, and so Dulong and Berzelius re-determined the density in Berthollet's laboratory at Arcueil, with the apparatus which had been used by Biot and Arago. From the result of these experiments he computed the atomic weight of carbon as 76.43 ( $O=100$ ), and this number was generally accepted with the confidence which Berzelius' great skill and accuracy in analysis had inspired in the minds of all chemists.

After Dumas' expression of doubt in 1838, Berzelius examined the subject again, determining the atomic weight of carbon, by anal-



ysis of lead carbonate and lead oxalate, and found no reason to suppose that his previous determination was in error. Much interest was of course felt in a matter of so much practical importance. Dumas and Stas therefore made many determinations of the atomic weight of carbon, by the most direct possible method, involving the atomic weight of no other element, and involving no assumption of the exactness of the laws of Boyle and Charles. Some notice of their result was read before the Academy in August, 1840, and the complete memoir was read in December and was published in the first number of the first volume of the new series of the *Annales*. They made three series of determinations, in which natural graphite, artificial graphite, and diamond, were successively burned in a current of oxygen. The oxygen was purified from carbon dioxide by being kept over milk of lime and by passing over potassium hydroxide, and dried by passing over sulphuric acid. The graphite or diamond was placed in a platinum boat in a porcelain tube; and the water formed, if any, and the carbon dioxide, were absorbed in the usual way, after proving that, in both cases, the absorption was complete. No graphite, and no diamond of the quality used for experiment, failed to leave an incombustible residue, the amount of which was determined in each case. The mean error of a determination was one part in twelve hundred, and the mean of all the results was 74.97 ( $O=100$ ). They considered the determination made by the combustion of diamond to be the most trustworthy, and assigned the number 75.02 as the result of their experiment. It may be said that two determinations by other chemists have been made since and have given precisely the latter number; and also that Stas himself later attempted a determination of the atomic weight of carbon by burning carbon monoxide to carbon dioxide, and found that the number is between 12.00 and 12.01 ( $O=16$ ). This later investigation seems not to have been published except in a too brief abstract.

Dumas and Stas planned a determination of the composition of water, and Stas assisted in the preliminary experiments; at this time he was appointed professor of chemistry in L'Ecole Militaire at Brussels, and the scientific partnership was dissolved. After this time by far the most important work of Stas related to atomic weights and to the constitution of matter.

In 1815 an anonymous article was published in Thompson's *Annals of Philosophy*, which the editor two years later ascribed to Dr. William Prout. Its title was, "On the Relation between the Specific Gravity of Bodies in their Gaseous State, and the Weights of their Atoms." Its doctrine was that all atomic weights are multiples of the atomic weight of hydrogen, and it was suggested that all the other elements are compounds. Now, Dumas and Stas had found the atomic weight of carbon to be 12.00. Dumas found the atomic weight of oxygen to be 16. Dumas and Bous-singault satisfied themselves, during their analysis of air, that the atomic weight of nitrogen is very nearly 14, and Dumas computed from his analysis of Iceland spar that the atomic weight of calcium was precisely 40. Berzelius had judged that the splendid series of determinations of atomic weights which science owed to his skill had disproved Prout's hypothesis; but Dumas and Stas had now shown that Berzelius' determinations of the atomic weights of oxygen and of carbon were in error by one-sixtieth and one-fiftieth respectively. So Dumas wrote, "I have said, and I repeat, that all the atomic weights need careful revision; that, neither accepting nor rejecting the hypothesis of Dr. Prout, I am forced to grant that it agrees with my own experiment, and that therefore there is here a promising opportunity for research, where one might have thought that further determinations were needless." A similar opinion may be fairly ascribed to Stas, who wrote, in 1860, that when he began his work in atomic weights he felt an almost absolute confidence in the truth of the hypothesis of Prout. Dumas added that he was too much occupied with other matters to labor in the new field suggested, and hoped that others would enter upon it; his hope was well justified by the career of his able pupil.

The time when Stas began his work cannot be exactly stated with the memoranda at hand at the present writing, but some important determinations were made as early as 1843. All the work accomplished up to 1860 was published at once. In 1842 and 1843 Marignac had enriched science with his masterly determinations of the atomic weights of chlorine, bromine, iodine, nitrogen, potassium and silver, and in 1857 Dumas published

determinations of the atomic weights of no less than twenty-six elements. "Marignac," says Stas, "stoutly declared that, considering the extreme difficulty of arriving by experiment at absolutely accurate results, the atomic weights which he had found for silver, potassium, bromine, iodine and nitrogen should not be considered contrary to Prout's hypothesis." Dumas expressed himself even more strongly in favor of the hypothesis. It was to this problem, so interesting in itself, and enlisting at the time so much attention from so great masters in science, that Stas devoted all his leisure for many years. On this subject he published a paper of 128 pages in the *Bulletin of the Academie des Sciences*, 1860; a paper of 311 quarto pages in *Memoires de l'Academie Royale \* \* \* de Belgique*, 1865; a paper of 165 pages in the *Annales de Chimie et de Physique*, 1872 and 1873; and a paper of 103 quarto pages in the same *Memoires*, read in 1876 and printed in 1881. The third of these papers may be regarded as preliminary to the fourth and contains no determination of atomic weights. The greatest part of the work of Stas up to 1880 is contained in these admirable papers. In them he has not given any details excepting those necessary to enable a reader to judge of the value of his experiments and of the confidence which might properly be felt in them. Such details are given in the most clear and lucid manner.

He used four balances. One was made by Gambey, and carried one kilogramme in each pan, and turned, with this load, with an excess of five-tenths of a milligramme. A second was made by Sacré, could carry five kilogrammes, turning then with one milligramme; when loaded with two or three kilogrammes in each pan it turned with three-tenths or four-tenths of a milligramme. A third carried five hundred grammes in each pan, then turning with two-tenths of a milligramme. A fourth carried twenty-five grammes in each pan, and then turned with one-thirtieth of a milligramme. Stas says, "I do not believe there exists another set of balances which for sensibility and constancy are to be compared with these. Every chemist who has had occasion to examine them has come to the same conclusion."

Stas used every refinement as to accuracy of weights and methods of weighing, but these need not be described. His study

of vessels suitable for use in his determination was most accurate and thorough. As a result of much painstaking, he was able to heat flasks for a whole day to such a degree that the glass became milky and white without in the least altering their weight. He proved that below  $300^{\circ}$  to  $350^{\circ}$  C. neither hydrochloric acid nor nitric acid had any appreciable action on the glass used by him. Berzelius had doubted the inalterability of glass and porcelain employed in analysis, and his doubts were pronounced by Stas to be well founded. No one will ever know the amount of labor involved in removing this source of error.

The reagents used in determinations had to be prepared in a state of such purity that they would not alter the weight or composition of the bodies formed or decomposed. Stas describes minutely the pains taken to secure and prove the purity of his reagents. He found that all ordinary water distilled twice, using a platinum condenser for the second distillation, contains organic matter, volatile at first, but afterwards becoming non-volatile. Such water leaves a residue of carbon on evaporation. At first he obtained pure water by slowly passing steam over hot copper oxide. In after years he devised a process with permanganate which was much more rapid, and gave equally pure water. So his method for obtaining hydrochloric, nitric and sulphuric acids, ammonium chloride and sodium carbonate were models of patient care to eliminate every source of systematic error.

In the first paper there are contained 112 determinations of ratios giving atomic weights. These are in twelve series; nine of these series contain silver in one term of the ratio. The amount of care taken to secure pure silver has never been equalled in any chemical investigation whatever, and does not at present seem likely ever to be much surpassed. He left nothing undone which it was possible to conceive as being of advantage. He used every method ever suggested; he found that all methods capable of being used on a sufficiently large scale failed to give pure silver except as these methods were modified by himself. He found how to get silver chloride free from copper and iron, but when it was reduced by Gay Lussac's method the metal contained silicon. Several facts led him to believe that silver acts upon silicon,

especially in presence of carbon. By fusing silver chloride with sodium carbonate and potassium nitrate with many precautions and fusing the metals again with nitrate and borax he obtained a pure metal. Stas prepared many kilogrammes in this way. He prepared three kilogrammes of pure silver by reducing an alkaline silver solution with lactose and fusing the reduced metal with nitre and borax. This gave a silver always having the same properties, and having the same properties as pure silver prepared in other ways.

In order to know whether the silver prepared in those ways was pure, pure silver was prepared by other processes. Silver was deposited by electrolysis upon a porcelain plate and fused with nitre and borax. Silver was reduced from the nitrate by phosphorus: the action is very slow; it is the reaction by which Stas obtained the first pure silver he ever possessed. Silver was also prepared by heating the pure acetate and subsequent fusion with nitre and borax; but it was not so pure as the preceding.

A simple plan for discovering the purity of silver consisted in heating the metal in air to a temperature sufficient to volatilize it. The pure metal then shows no scum and no colored vapor. But if it contains two-millionths of iron, copper, or silicon, it becomes covered with a very strong, mobile scum when so heated. Silicon with a trace of copper gives a colored flame.

The purity of silver was originally tested by converting from 100 to 200 grammes into the nitrate, fusing, and dissolving in water, when ferric oxide and silica were left. The objection to sacrificing so much of the hardly obtained pure metal led to the use of the wet assay of Gay Lussac.

The silver before being used was cast in moulds lined with pipe clay and then the surface was cleaned by an elaborate process. Smaller lumps were obtained by cutting and then removing iron by a proper solvent. Sheets were obtained by rolling pure silver between silver plates; since otherwise silver, which before was pure, became contaminated with iron which could not be removed. Stas for a long time thought silver so obtained was pure, but when using 400 grammes of silver for a synthesis of the nitrate, he found it still contained one part in fifty thousand of silica. In after years he found a better process.

With silver of this purity, Stas made seven syntheses of silver chloride by four different methods. With unsurpassed insight he detected sources of minute constant error and found that some promising methods are open to grave doubts unless confirmed by other methods. The difference between the maximum and minimum of these seven results was one part in sixteen thousand. With a sagacity justified by subsequent determinations, he judged that a number a little larger than the maximum was the truth.

Next are detailed eight syntheses of silver nitrate, made on such quantities as two hundred, three hundred, and even four hundred grammes; and five syntheses of silver sulphide, on quantities but little smaller. Then came the details of a piece of work of almost unparalleled accuracy: twenty-four determinations of the ratio between silver and potassium chloride of which the mean error is one part in 48,000; ten of the ratio of silver to sodium chloride, with a mean error of one part in 61,000; ten of the ratio of silver to ammonium chloride, with a mean error of one part in 14,600; and ten of the ratio of silver nitrate to potassium chloride, with a mean error of one part in 10,000; shortly after are ten determinations of the ratio of lead to lead nitrate with a mean error of one part in 30,000. Determinations of a single ratio have been made by other chemists with even a smaller mean error; as for instance, in Crooke's work on thallium; but it is safe to say that so accurate and so numerous determinations of so many ratios, by processes so varied for each ratio, will long remain an unequalled achievement of indomitable courage and patience combined with the highest scientific attainments and the clearest insight. Of these experiments Stas says, "In order to make the results control each other, I have repeated the determinations so great a number of times that I much doubt whether there exists in the annals of chemical science an example of a greater endeavor to discover the truth. I have devoted a whole year to [one part of] these experiments which appear so simple."

The work of 1860 contained some twenty other determinations which there is not space to mention in detail, and ends with a clear summary of the facts obtained by experiment, and of the conclusions as to the validity of Prout's hypothesis which they justify.

His opinion is stated in these words ; " I therefore conclude by saying, so long as our recourse must be made to experiment to establish the laws which govern matter, we must consider Prout's hypothesis as a pure illusion, and must regard the undecomposed bodies of our globe as distinct entities having no simple relations of weight among themselves."

Stas was his own most rigorous critic ; but some other criticism was not wanting. Marignac made some comments on the work of Stas which were important in their results. He argued, from the fact that the difference was so small between his own results and the results of work in which infinitely more minute precautions were taken, that, if some one in the future should greatly surpass even Stas in the precautions taken against error, the atomic weights then determined would not agree sensibly better with Prout's hypothesis. But he did not therefore abandon the hypothesis as ill-founded. He suggested that just as sulphuric acid contains an excess of water when it is in its most stable condition, so the compounds analyzed, or prepared by synthesis, in the experiments of Stas, might contain an excess of one of the elements, slight indeed, but perceptible in such delicate experiments. For instance, perhaps silver sulphide or silver nitrate may contain an excess of sulphur or of nitrogen and oxygen.

This led Stas to undertake his second great work on atomic weights. He attempted first to supply the proof that *stable* bodies have rigorously the same composition ; and this by two methods. He prepared ammonium chloride under varying conditions of temperature and pressure, from ammonia derived from the most different sources, and proved that its composition is constant. He also proved that silver chloride is of constant composition, notwithstanding difference of temperature in its preparation. For use in some of his experiments, he prepared silver by reducing the chloride with potassum hydroxide and lactose ; in others, he reduced an ammoniacal solution of silver with ammonium sulphite. The purity of the metal was proved by distillation in a lime retort with the oxy-hydrogen blowpipe, and the pure silver thus obtained was used as a standard with which all other silver was compared by titration.



Then he showed that the ratio of silver to chlorine, bromine, and iodine, is the same in the halides and the oxy-salts of these elements. Great difficulties were surmounted in this investigation. The preparation of the pure compounds of silver needed was exceedingly laborious ; but this was not unexpected. But one difficulty was such that even Stas would not have had the courage to go on in the face of it, except that he did not know of it beforehand. He found, *after his experiments were made*, that the solution of sulphur dioxide used in these experiments is altered by the action of light. While the fresh solution acting in darkness simply reduces the oxy-salts to halides, the solution exposed to light not only reduces, but also forms sulphur compounds of silver. Chance, he says, served him wonderfully well ; his luck was better than his lookout. It happened that he always used either a current of gaseous sulphur dioxide, or a solution prepared in darkness and used at once before the change could take place. These most laborious determinations seem to have consumed over two years ; they proved that the proportion of silver to the halogen is the same in the halide and the oxy-salt. From the two series of investigation he concludes that when compounds are formed in normal conditions, they contain their elements in rigorously constant ratio.

Next Stas attacked again the question whether the atomic weight of silver is the same, whether it be determined by means of chlorine, of bromine, or of iodine ; and whether these four atomic weights agree with Prout's hypothesis. In this research, he practiced what he called a *complete* synthesis, or *complete* analysis. That is to say, in a synthesis of the two bodies A and B, he weighed A, weighed B, and weighed the resulting compound AB. In an analysis of ABC, he weighed ABC, and weighed each of the products AB and C, into which it was decomposed. In this way he could exactly estimate the limits of error of the experiment. The labor was immense. He wrote : "The manipulations which I have briefly described were so long, so laborious, and so painful, that now, after a year, the remembrance of the fatigue they cost me is still vivid ; and courage to undertake them again would fail me. There does not exist in the annals of science, an analysis made upon an equal amount of a salt so difficult to obtain pure."



Unexampled pains were taken in preparing pure iodine and pure bromine by different processes. Sometimes iodine was prepared by precipitating it from a saturated solution of potassium iodide. Sometimes iodine was converted into nitrogen iodide, and this was decomposed and iodine set free. Stas used to produce five hundred grammes of nitrogen iodide at one operation ; he prepared several kilogrammes of it without the slightest accident. Iodine prepared in either of these ways was distilled with barium oxide. A weighed quantity of the pure iodine was made to act upon a weighed quantity of pure silver and the resulting iodide was weighed. This was done in some cases by transforming the silver first into the sulphate, in others, by transforming the iodide into ammonium iodide. Eight determinations were made, with a mean error of about one part in 20,000.

Bromine was prepared by distilling with sulphuric acid a mixture of bromide and bromate of potassium, or of barium. A weighed quantity of bromine was combined with a weighed quantity of silver, and the resulting bromide was weighed ; five determinations being completed.

Silver iodate, bromate and chlorate, were prepared with all imaginary care to obtain pure salts. The iodate was decomposed by heating, the oxygen was collected in a tube filled with heated copper, and weighed, and a little water from which it was impossible to free the iodate was also collected and weighed. Such was the stupendous care and skill with which these manipulations were conducted, that the sum of the products agreed with the weight of the iodate taken within one part in 60,000.

When Stas attempted to decompose the bromate in the same way, for eight hours the evolution of oxygen was regular, but then, without obvious cause, one part of the mass became incandescent, a rapid evolution of oxygen began, and the apparatus exploded with much violence. Some other way must therefore be used for this analysis, and the hope of collecting and weighing the oxygen was abandoned. In this part of the work, seven analyses were made.

Stas next determined the atomic weights of nitrogen, chlorine, bromine, silver, potassium, lithium and sodium, by processes dif-

ferent from those which he had used before, in order to subject his former results to a rigorous control. He prepared the chlorides of sodium, potassium and lithium, with the most scrupulous care, by every available method, and then transformed a weighed quantity of one of these chlorides into the corresponding nitrate. He had to make a laborious study in order to find a mixture for making a glass which would resist the action of nitric acid in the necessary evaporations. In preparing the potassium chloride needed in these investigations, Stas prepared platinum-potassium chloride in large quantity. Hoping to determine the atomic weight of platinum, he took his usual care to prepare pure platinum, but in this hope he was disappointed, for it was impossible completely to dry the double chloride, and the immense care spent in the purification of the platinum was entirely lost. This part of the work contains thirty-four determinations.

Stas had thus submitted Prout's hypothesis to the test of experiment even more rigorous than that of his earlier work. He had himself become the chemist hoped for by Marignac, who, with "new improvements in the method of purifying bodies and in the methods of experiment, should undertake again the same series of experiments with yet greater guarantees of accuracy." The agreement of the later results with the earlier is nothing less than astonishing; and if it were not for subsequent work of Stas, one would say the limit of human accuracy had been here attained. But more was to come.

In 1872 and 1874, Stas published some 150 pages on the properties of the different modifications of silver chloride and silver bromide. One object was to study the means of determining with the greatest possible accuracy the relation between silver and either of these halogens by the method of Gay Lussac, and then to use the perfected method for a re-determination of some atomic weights. These re-determinations were submitted to the Academie Royale in 1876 and published in 1881. The long labor spent in studying facts which at first seemed anomalous had made him so familiar with the method that what was once an almost insurmountable difficulty had become easy, and errors had become measurable. Some of the titrations by his perfected method occupied six per-

sons for nine hours in determining the point where silver and chlorine were equivalent in the solution used in experiment ; the mean error of these experiments was one part in 400,000, notwithstanding the fact that the halide was prepared by different methods. Twenty-four experiments are contained in this series. It also contained an explanation of the way to obtain pure hydrobromic acid, with the object of replacing chlorine by bromine in the wet assay of silver, since it is easy to determine the point where silver and bromine are equivalent in a liquid, for silver bromide is less soluble than silver chloride.

At the close of this tremendous series of labors, Stas appealed again to chemists to repeat some one of his determinations. " If," he said, " such investigation should confirm my own persevering investigations, perhaps those who believe in the existence of one primary form of matter will tell us how they conceive that the products of aggregation of this primary matter afford masses having to each other incommensurable ratios. Until this explanation is given, the hypothesis of the existence of one primary form of matter cannot take any place in science, because it cannot be considered as possibly true." He had proven, if human labor can ever prove anything, that the atomic weights which he studied are not in the ratio of whole numbers.

But he was to continue his inquiry into the ultimate nature of matter by a very different method. The account of these labors has been presented to the Belgian Academy ; but, so far as known to the writer, it is not yet published, so that our knowledge of them is rather general.

In 1878 Lockyer published some facts, which appeared to him to show that several of the supposed elements are compounds capable of dissociation by heat. The facts related to the spectra of these elements at different temperatures. Lockyer argued that the facts fairly led us to suppose, that, as a compound gives a spectrum at a low temperature, but at a high temperature breaks up into its elements and gives their spectra, so elements themselves, at still higher temperatures, break up into simpler forms of matter, giving spectra different from those of the elements supposed to undergo the decomposition. Such a theory could not

fail to interest Stas, and he set himself to find whether the observed appearances would be seen with bodies purified as he had learned to purify. It took eleven years, we are told, to prepare substances which Stas would call pure. He obtained potassium chloride which he called perfectly pure; especially was it absolutely free from sodium. He experimented on silver, sodium, potassium, lithium, calcium, strontium, barium, thallium. He found that at the highest temperatures at which he worked, even at the melting point of iridium, the lines of the spectra of these elements remained the same, and these elements were not dissociated or decomposed. This work, costing so immense an amount of labor, may well be considered the crowning work of Stas.

Stas was a member for Belgium of the International Committee of Weights and Measures; and some of the most difficult labors of the committee fell to him. For instance, he took an active part in the analyses and investigations which led to the selection of the alloy of ninety parts of platinum and ten parts of iridium used for the standard weights and measures. The results of this labor are contained in the *Procès-Verbaux du Comité*. In the analyses of the alloy used in order to determine whether its composition was that intended, the duplicate analyses by Stas agreed with the same accuracy as his determinations of atomic weight.

Stas performed many services for his country and for his fellow citizens which were of more immediate and direct advantage. On the occasion of a murder by poisoning, he developed the method of separating and detecting the poisonous alkaloids, which, with some modifications by Otto, is a standard method. He performed important services for the Ordnance Department of the Belgian Government. He studied the methods of saponification of fats and perfected the method which is now in use.

The work of Stas was not such as to bring him any popular recognition at all commensurate with the very great merit and importance of his work. But of the kind of recognition which was no doubt more acceptable to him he had abundance. For instance Clarke, speaking of the work of Stas, uses the phrase "magnificent accuracy." Meyer and Seubert speak of the "unsurpassed precautions, painstaking care and admirable skill" of the work of Stas.

All who have had occasion to look into the matter would agree with the writer that even stronger expressions of admiration would have been appropriate. The opinion of competent judges was also expressed in the bestowal of academic honors; he was President of the Royal Belgian Academy of Science; Foreign Member of the Royal Society of London; Corresponding Member of the Academy of Science at Paris; he received the Davy Medal of the Royal Society in 1885. President Huxley, in presenting the medal, said: "The indefatigable and conscientious care which M. Stas has devoted to the re-determining of a certain number of the most important atomic weights, and the marvelous skill with which he has overcome the various difficulties which successively presented themselves, render his memoir on the subject one of the most remarkable and valuable of chemical monographs." He was an honorary member of the German Chemical Society, and of the American Chemical Society; he was a Grand Officer of the Belgian Order of Leopold, of the French Legion of Honor, and Knight of many other orders throughout Europe.

More than twenty-five years of his life Stas was professor of chemistry in the Military School at Brussels; the salary was small. An affection of the larynx made it necessary for him to resign, and this before the thirty years of service which would have entitled him to a pension. He afterwards had a post in connection with the mint at Brussels, but he soon resigned the post rather than countenance a decision which he knew to be contrary to public interests.

Stas was elected a member of the Royal Belgian Academy of Science in 1841. In 1891 the completion of fifty years of connection with the Academy was celebrated by a brilliant manifestation. The three classes of the Academy met in joint session. The President of the Academy and the Director of the Class of Science made addresses. Spring pronounced an oration on the life and work of Stas. A medal was struck and presented to him; the city of his birth sent its mayor with an address of congratulation; the many learned societies of which Stas was a member sent felicitations; three universities sent him the diploma of Doctor, *Honoris Causa*. A memorial of this manifestation was printed in ninety-eight pages.

The place of Stas on the roll of scientific men will doubtless long continue to be unique. The gift of so many admirable qualities, in so high a degree, and in such well ordered balance, can recur but seldom. Many may possess patience as unwearied and wonderful. Many may be as resolute in endurance of hard labor ; though to not many is given to work without interruption for sixty consecutive hours in circumstances of extreme physical discomfort without some fatal oversight or momentary failure of attention. Many may attain a love of the truth as conscientious, as simple minded, and a forgetfulness of self-interest as entire. Many may as thoroughly grasp the whole amount of knowledge related to a given research so far acquired by men. Some may possess as sound a judgment ; many, as clear and true a penetration into the nature and causes of phenomena ; many, as acute insight into sources of error ; some, a manipulative skill as unerring. But patience so wise and resolute, combined with so high a love for the truth and so entire forgetfulness of personal relations to the truth, combined also with such insight and acuteness, assisted by skill so unerring, and balanced and rounded out by so much soundness of judgment, will not quickly be seen again. Not soon can so much work, of such unsurpassed accuracy, be accomplished by one of the human race in its present stage of attainment. So his name will long stand in a position in many respects unique ; always will it be remembered, by those who are interested in pushing our knowledge of the ultimate nature of matter to the utmost range of possibility, with admiration and with enthusiastic gratitude. As was said on the medal struck in honor of his jubilee,

*Servatus Stas et usque in memoria stabis.*

EDWARD W. MORLEY.

## THE IMMEDIATE WORK IN CHEMICAL SCIENCE.\*

BY ALBERT B. PRESCOTT.

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A division of science has a work of its own to do, a work that well might be done for its own sake, and still more must be done in payment of what is due to the other divisions. Each section of our Association has its just task, and fidelity to this is an obligation to all the sections. Those engaged in any labor of science owe a debt to the world at large, and can be called to give an account of what they are doing, and what they have to do, that the truth may be shown on all sides.

If it be in my power to make the annual address of this meeting of any service at all to you who hear it—in your loyalty to the Association—I would bring before you some account of the work that is wanted in the science of chemistry. Of what the chemists have done in the past the arts of industry speak more plainly than the words of any address. Of what chemists may do in the future it would be quite in vain that I should venture to predict. But of the nature of the work that is waiting in the chemical world at the present time I desire to say what I can, and I desire to speak in the interests of science in general. The interests of science, I am well assured, cannot be held indifferent to the interests of the public at large.

It is not a small task, to find out how the matter of the universe is made. The task is hard, not because of the great quantity in which matter exists, nor by reason of the multiplicity of the kinds and compounds of matter, but rather from the obscurity under which the actual composition of matter is hidden from man. The physicists reach a conclusion that matter is an array of molecules—

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\*An address by the retiring President of the American Association for the Advancement of Science at the Rochester meeting of the Association, August 17, 1892. Reprinted from the Proceedings of the American Association for the Advancement of Science. Vol. XLI., 1892.

little things, not so large as a millionth of a millimeter in size—and the formation of these they leave to the work of the chemists. The smallest objects dealt with in science, their most distinct activities become known only by the widest exercise of inductive reason.

The realm of chemical action, the world within the molecules of matter, the abode of the chemical atoms, is indeed a new world and but little known. The speculative atoms of the ancients, mere mechanical divisions, prefiguring the molecules of modern science, yet gave no sign of the chemical atoms of this century, nor any account of what happens in a chemical change. A new field of knowledge was opened in 1774 by the discovery of oxygen, and entered upon in 1804 by the publication of Dalton, a region more remote and more difficult of access than was the unknown continent toward which Christopher Columbus set his sails three centuries earlier. The world within molecules has been open for only a hundred years. The sixteenth century was not long enough for an exploration of the continent of America, and the nineteenth has not been long enough for the undertaking of the chemists. When four centuries of search shall have been made in the world of chemical formation, then science should be ready to meet a congress of nations, to rejoice with the chemist upon the issue of his task.

It is well known that chemical labor has not been barren of returns. The products of chemical action, numbering thousands of thousands, have been sifted and measured and weighed. If you ask what happens in a common chemical change you can obtain direct answers. When coal burns in the air, how much oxygen is used up, can be stated with a degree of exactness true to the first decimal of mass, perhaps to the second, yet questionable in the third. How much carbonic acid is made can be told in weight and volume with approaching exactness. How much heat this chemical action is worth, how much light, how much electromotive force, what train-load of cars it can carry, how long it can make certain wheels go round,—for these questions chemists and physicists are ready. With how many metals carbonic acid will unite, how many ethers it can make into carbonates, into what



classes of molecules a certain larger fragment of carbonic acid can be formed ; the incomplete records of these things already run through a great many volumes. These carboxylic bodies are open to productive studies, stimulated by various sorts of inquiry and demands of life. Such have been the gatherings of research. They have been slowly drawn into order, more slowly interpreted in meaning. The advance has been constant, deliberate, sometimes in doubt, always persisting and gradually gaining firmer ground. So chemistry has reached *the period of definition*. Its guiding theory has come to be realized.

“The atomic theory” has more and more plainly appeared to be the central and vital truth of chemical science. As a working hypothesis it has directed abstruse research through difficult ways to open accomplishment in vivid reality. As a system of knowledge, it has more than kept pace with the rate of invention. As a philosophy, it is in touch with profound truth in physics, in the mineral kingdom, and in the functions of living bodies. As a language it has been a necessity of man dealing with chemical events. Something might have been done no doubt, without it, had it been possible to keep it out of the chemical mind. But with a knowledge of the primary elements of matter, as held at the beginning of this century, some theory of chemical atoms was inevitable. And whatever theory might have been adapted, its use in investigation would have drawn it with a certainty into the essential features of the theory now established. It states the constitution of matter in terms that stand for things as they are made. The mathematician may choose the ratio of numerical notation, whether the ratio of ten or some other, But the chemist must find existing ratios of atomic and molecular mass, with such degree of exactness as he can attain. Chemical notation, the index of the atomic system is imperfect, as science is incomplete. However defective, it is the resultant of a multitude of facts. The atomic theory has come to be more than facile language, more than lucid classification, more than working hypothesis, it is *the definition of the known truth in the existence of matter*.

The chemical atom is known, however, for what it does, rather than for what it is. It is known as a center of action, a factor of

influence, an agent of power. It is identified by its responses, and measured by its energies. Concealed as it is, each atom has given proof of its own part in the structure of a molecule. Proofs of position, not in space but in action, as related to other atoms, have been obtained by a multitude of workers with the greatest advantage. The arrangement of the atoms in space, however, is another and later question, not involved in the general studies of structure. But even this question has arisen upon its own chemical evidences, for certain bodies, so that "the configuration" of the molecule has become an object of active research.

Known for what it does, the atom is not clearly known for what it is. Chemists, at any rate, are concerned mainly with what can be made out of atoms, not with what atoms can be made of. Whatever they are, and by whatever force of motion it is that they unite with each other, we define them by their effects. Through their effects they are classified in the rank and file of the periodic system. The physicists, however, do not stop short of the philosophical study of the atom itself. As a vibratory body its movements have been under mathematical calculations; as a vortex ring its pulsations have been assumed to agree with its combining power. As an operating magnet its interaction with other like magnets has been predicated as the method of valence. There are, as I am directly assured, physicists of penetration and prudence now looking with confidence to studies of the magnetic relations of atoms to each other\*. Moreover, another company of workers, the chemists of geometric isomerism, assume a configuration of the atoms, in accord with that of the molecule.

The stimulating truth of the atomic constitution of the molecule, a great truth in elastic touch with all science, excites numerous hypotheses, which, however profitable they may be, are to be stoutly held at a distance from the truth itself. Such are the hypotheses of molecule aggregation into crystals and other mineral forms. Such are the biological theories of molecules polymerizing into cells, and of vitality as a chemical property of the molecule. Such are

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\* "The results of molecular physics point unmistakably to the atom as a magnet, in its chemical activities."—A. E. Dolbear, in a personal communication.

the questions of the nature of atoms, and the genesis of the elements as they are now known, questions on the border of metaphysics. Let all these be held distinct from the primary law of the atomic constitution of simple molecules in gaseous bodies, an essential principle in an exact science. The chemist should have the comfortable assurance, every day, as he plies his balance of precision, that the atom-made molecules are there, in their several ratios of quantity, however many unsettled questions may lie around about them. Knowledge of molecular structure makes chemistry a science, nourishing to the reason, giving dominion over matter for beneficence to life.

Every chemical pursuit receives strength from every advance in the knowledge of the molecule. And to this knowledge, none the less, every chemical pursuit contributes. The analysis of a mineral, whether done for economic ends or not, may furnish a distinct contribution toward atomic valence. The further examination of steel in the cables of a suspension bridge is liable to lead to unexpected evidence upon polymeric unions. Rothamsted farm, where ten years is not a long time for the holding of an experiment, yields to us a classic history of the behavior of nitrogen, a history from which we correct our theories. The analysis of butter for its substitutes has done something to set us right upon the structure of the glycerides. Clinical inspection of the functions of the living body find a record of molecular transformations too difficult for the laboratory. The efforts of pharmaceutical manufacture stimulate new orders of chemical combination. The revision of the pharmacopœia every ten years points out a humiliating number of scattered errors in the published constants on which science depends. The duty of the engineer, in his scrutiny of the quality of lubricating oils, brings a more critical inquiry into the laws of molecular movement. There is not time to mention the many professions and pursuits of *men who contribute toward the principles of chemistry* and hold a share therein. If it be the part of pure science to find the law of action in nature, it is the part of applied science both to contribute facts and to put theory to the larger proof. In the words of one who has placed industry in the greatest of its debts to philosophic research, W. H. Perkins, "There is

no chasm between pure and applied science, they do not even stand side by side, but are linked together." So in all branches of chemistry, whether it be termed applied or not, the best workers are the most strongly bound as one, in their dependence upon what is known of the structure of the molecule.

Studies of structure were never before so inviting. In this direction and in that special opportunities appear. Moreover the actual worker here and there breaks into unexpected paths of promise. Certainly the sugar group is presenting to the chemist an open way from simple alcohols on through to the cell substances of the vegetable world. And nothing anywhere could be more suggestive than the extremely simple unions of nitrogen lately discovered. They are likely to elucidate linkings of this element in great classes of carbon compounds, all significant in general chemistry. Then certain comparative studies have new attractions. As halogens have been upon trial side by side with each other, so for instance, silicon must be put through its paces with carbon, and phosphorus with nitrogen. Presently, also, the limits of molecular mass, in polymers and in unions with water, are to be nearer approached from the chemical side, as well as from the side of physics, in that attractive but perplexing border ground between affinity and the states of aggregation.

Such is the extent and such the diversity of chemical labor at present that every man must put limits to the range of his study. The members of a society or section of chemistry, coming together to hear each other's researches, are better able, for the most part, to listen for instruction than for criticism. Still less prepared for hasty judgment are those who do not come together in societies at all. Even men of eminent learning must omit large parts of the subject, if it be permitted to speak of chemistry as a single subject. These considerations admonish us to be liberal. When metallurgical chemistry cultivates skepticism as to the work upon atomic closed chains, it is a culture not the most liberal. When a devotee of organic synthesis puts a low value upon analytic work, he takes a very narrow view of chemical studies. When the chemist who is in educational service disparages investigations done in industrial service, he exercises a pitiful brevity of wisdom.

The pride of pure science is justified in this, that its truth is for the nurture of man. And the ambition of industrial art is honored in this, its skill gives strength to man. It is the obligation of science to bring the resources of the earth, its vegetation and its animal life, into the full service of man, making the knowledge of creation a rich portion of his inheritance, in mind and estate, in reason and in conduct, for life present and life to come. To know creation is to be taught of God.

I have spoken of the century of beginning chemical labor, and have referred to the divisions and specialties of chemical study. What can I say of the means of uniting the earlier and later years of the past, as well as the separated pursuits of the present, in one mobile working force? Societies of science are among these means, and it becomes us to magnify their office. For them, however, all that we can do is worth more than all we can say. And there are other means, even more effective than associations. Most necessary of all the means of unification in science is the use of its literature.

It is by published communication that the worker is enabled to begin, not where the first investigation began, but where the last one left off. The enthusiast who lacks the patience to consult books, presuming to start anew all by himself in science, has need to get on faster than Antoine L. Lavoisier did when he began, an associate of the French Academy in 1768. He of immortal memory, after fifteen eventful years of momentous labor, reached only such a combustion of hydrogen as makes a very simple class experiment at present. But, however, early in chemical discovery, Lavoisier availed himself of contemporaries. They found oxygen, he learned oxidation; one great man was not enough, in 1774, both to reveal this element and show what part it takes in the formation of matter. The honor of Lavoisier is by no means the less that he used the results of others, it might have been the more had he given their results a more explicit mention. Men of the largest original power make the most of the results of other men. Discoverers do not neglect previous achievement, however it may appear in biography. The masters of science are under the limitations of their age. Had Joseph Priestly lived in the seventeenth

century he had not discovered oxygen. Had August Kekulé worked in the period of Berzelius, some other man would have set forth the closed chain of carbon combination, and Kekulé, we may be sure, would have done something else to clarify chemistry. Such being the limitations of the masters, what contributions can be expected in this age from a worker who is without the literature of his subject?

In many a town some solitary thinker is toiling intensely over some self-imposed problem, devoting to it such sincerity and strength as should be of real service, while still he obtains no recognition. Working without books, unaware of memoirs on the theme he loves, he tries the task of many with the strength of one. Such as he sometimes send communications to this association. An earnest worker, his utter isolation is quite enough to convert him into a crank. To every solitary investigator I should desire to say, get to a library of your subject, learn how to use its literature, and possess yourself of what there is on the theme of your choice, or else determine to give it up altogether. You may get on very well without college laboratories, you can survive it if unable to reach the meetings of men of learning, you can do without the counsel of an authority, but you can hardly be a contributor in science except you gain the use of its literature.

First in importance to the investigator are the original memoirs of previous investigators. The chemical determinations of the century have been reported by their authors in the periodicals. The serials of the years, the continuously living repositories of all chemistry, at once the oldest and the latest of its publications, these must be accessible to the worker who would add to this science. A library for research is voluminous, and portions of it are said to be scarce, nevertheless it ought to be largely supplied. The laboratory itself is not more important than the library of science. In the public libraries of our cities, in all colleges now being established, the original literature of science ought to be planted. It is a wholesome literature, at once a stimulant and a corrective of that impulse to discovery that is frequent among the people of this country. That a good deal of it is in foreign languages is hardly a disadvantage; there ought to be some exercise for the modern

tongues that even the public high schools are teaching. That the sets of standard journals are getting out of print is a somewhat infirm objection. They have no right to be out of print in these days when they give us twenty pages of blanket newspaper at breakfast, and offer us Scott's novels in full for less than the cost of a day's entertainment. As for the limited editions of the old sets, until reproduced by new types, they may be multiplied through photographic methods. When there is a due demand for the original literature of chemistry, a demand in accord with the prospective need for its use, the supply will come, let us believe, more nearly within the means of those who require it than it now does.

What I have said of the literature of one science can be said, in the main, of the literature of the other sciences. And other things ought to be said, of what is wanted to make the literature of science more accessible to consulting readers. *A great deal of indexing is wanted.* Systematic bibliography, both of previous and of current literature, would add a third to the productive power of a large number of workers. It would promote common acquaintance with the original communications of research, and a general demand for the serial sets. Topical bibliographies are of great service. In this regard I desire to ask attention to the annual reports of the committee on Indexing Chemical Literature, in this association for nine years past, as well to recent systematic undertakings in geology, and like movements in zoology and other sciences. Also to the Index Medicus, as a continuous bibliography of current professional literature.

Societies and institutions of science may well act as patrons to the bibliography of research, the importance of which has been recognized by the fathers of this Association. In 1855, Joseph Henry, then a past president of this body, memorialized the British Association for coöperation in bibliography, offering that aid of the Smithsonian Institution which has so often been afforded to publications of special service. The British Association appointed a committee, who reported in 1857, after which the undertaking was proposed to the Royal Society. The Royal Society made an appeal to her Majesty's government, and obtained the necessary stipend. Such was the inception of the Royal Society Catalogue



of scientific papers of this century, in eight quarto volumes, as issued in 1867 and 1877. Seriously curtailed from the generous plan of the committee who proposed it, limited to the single feature of an appendix of authors, it is nevertheless of great help in literary search. Before any list of papers, however, we must place a list of the serials that contain them, as registered by an active member of this Association, an instance of industry and critical judgment. I refer to the well-known catalogue of scientific and technical periodicals, of about five thousand numbers, in publication from 1665 to 1882, together with the catalogue of chemical periodicals by the same author.\*

Allied to the much needed service in bibliography, is the service in compilation of the Constants of Nature. In the preface of his dictionary of solubilities, in 1856, Professor Storer said "that chemical science itself might gain many advantages if all known facts regarding solubility were gathered from their widely scattered original sources into one special comprehensive work." That the time of the philosophical study of solution was near at hand has been verified by recent extended monographs on this subject. In like manner Thomas Carnelley in England, and early and repeatedly our own Professor Clarke in the United States,† bringing multitudes of scattered results into coördination, have augmented the powers of chemical service.

What bibliography does for research, the Handwörterbuch does for education, and for technology. It makes science wieldy to the student, the teacher, and the artisan. The chief dictionaries of

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\* Bolton's Catalogue of Scientific and Technical Periodicals (1885: Smithsonian) omits the serials of the societies, as these are the subject of Scudder's Catalogue of Scientific Serials (1879: Harvard Univ.). On the contrary Bolton's Catalogue of Chemical Periodicals (1885: N. Y. Acad. Sci.) includes the publications of societies as well as other serials. Chemical technology is also represented in the last named work.

† The service of compilation of this character is again indicated by this extract from Clarke's introduction to the first edition of his "Constants" (1873): "While engaged upon the study of some interesting points in theoretical chemistry, the compiler of the following tables had occasion to make frequent reference to the then existing lists of specific gravities. None of these, however, were complete enough. . . ."



science, those of encyclopedic scope, ought to be provided generally in public libraries, as well as in the libraries of all high schools.\* The science classes in preparatory schools should make an acquaintance with scientific literature in this form. If scholars be assigned exercises which compel reference reading, they will gain a beginning of that accomplishment too often neglected, even in college, how to use books.

The library is a necessity of the laboratory. Indeed, there is much in common between what is called the laboratory method, and what might be called the library method, in college training. The educational laboratory was instituted by chemistry, first taking form under Liebig at Giessen only about fifty years ago. Experimental study has been adopted in one subject after another, until now the "laboratory method" is advocated in language and literature, in philosophy and law. It is to be hoped that chemistry will not fall behind in the later applications of "the new education" in which she took so early a part.

The advancement of chemical science is not confined to discovery, nor to education, nor to economic use. All of those interests it should embrace. To disparage one of them is injurious to the others. Indeed they ought to have equal support. It would be idle to inquire into their respective advantages. This much, however, is evident enough, chemical work is extensive and there is immediate want of it.

Various other branches of science are held back by the delay of chemistry. Many of the material resources of the world wait upon its progress. In the century just before us the demands upon the chemist are to be much greater than they have been. All the interests of life are calling for better chemical information. Men are wanting the truth. The biologist on the one hand, and the geologist on the other, are shaming us with interrogatories that ought to be answered. Philosophy lingers for the results of molecular inquiry. Moreover the people are asking direct questions

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† The statistics of school libraries in the United States are very meagre, the expenditures for them being included with that for apparatus. For libraries and apparatus of all common schools, both primary and secondary, the annual expenditure is set at \$987,048, which is about seven-tenths of one per cent of the total expenditure for these schools.

about the food they are to eat, or not to eat, asking more in a day than the analyst is able to answer in a month. The nutritive sources of bodily power are not safe, in the midst of the reckless activity of commerce, unless a chemical safeguard be kept, a guard who must the better prepare himself for his duty.

Now if the people at large can but gain a more true estimation of the bearing of chemical knowledge, and of the extent of the chemical undertaking, they will more liberally supply the sinews of thorough-going toil. It must be more widely understood that achievements of science, such as have already multiplied the hands of industry, do not come by chances of invention, nor by surprises of genius. It must be learned of these things that they come by breadth of study, by patience in experiment, and by the slow accumulations of numberless workers. And it must be made to appear that the downright labor of science actually depends upon means of daily subsistence. It must be brought home to men of affairs, that laboratories of seclusion with delicate apparatus, that libraries, such as bring all workers together in effect, that these really cost something in the same dollars by which the products of industrial science are measured. Statistics of chemical industry are often used to give point to the claims of science. For instance, it can be said that this country, not making enough chemical wood pulp, has paid over a million dollars a year for its importation. That Great Britain pays twelve million dollars a year for artificial fertilizers, from without. That coal tar is no longer counted a by-product, having risen in its value to a par with coal gas. But these instances, as striking as numerous others, still tend to divert attention from the more general service of chemistry as it should be known in all the economies of civilization.

It is not for me to say what supplies are wanted for the work of chemists. These wants are stated, in quite definite terms, by a sufficient number of those who can speak for themselves. But if my voice could reach those who hold the supplies, I would plead a most considerate hearing of all chemical requisitions, and that a strong and generous policy may in all cases prevail in their behalf.

If any event of the year is able to compel the attention of the world to the interests of research, it must be the notable close of

that life of fifty years of enlarged chemical labor, announced from Berlin a few months ago. When thirty years of age, August Wilhelm von Hofmann, a native of Giessen and a pupil of Liebig, was called to work in London. Taking hold of the organic derivatives of ammonia, and presently adopting the new discoveries of Wurtz, he began those masterly contributions that appear to have been so many distinct steps toward a chemistry of nitrogen, such as industry and agriculture and medicine have thriven upon. In 1850 he opened a memoir in the philosophical transactions with these words, "the light now begins to dawn upon the chaos of collected facts." Since that time the coal tar industry has risen and matured, medicine has learned to measure the treatment of disease, and agriculture to estimate the fertility of the earth. It seems impossible that so late as March of the present year he was still sending his papers to the journals. If we could say something of what he has done, we could say nothing of what he has caused others to do. And yet, let it be heard in these United States, without such a generous policy of expenditure for science as gave to Dr. Hofmann his training in Giessen, or brought him to London in 1848, or built for him laboratories in Bonn and Berlin, without such *provision by the State*, the fruits of his service would have been lost to the world. Aye, and for want of a like broad and prudent provision for research with higher education in this country, other men of great love for science and great power of investigation every year fail of their rightful career for the service of mankind.

For the prosecution of research, in the larger questions now before us, no training within the limitations of human life can be too broad or too deep. No provision of revenue, so far as of real use to science, can be too liberal. The truest investigation is the most prudent expenditure that can be made.

In respect to the support that is wanted for work in science, I have reason for speaking in confidence. If I go beyond the subject with which I began, I do not go beyond the warrant of the Association. This body has lately defined what its members may say by creating a committee to receive endowments for the support of research.

There are men and women who have been so far rewarded that great means of progress are in their hands, to be vigorously held for the best advantage. Strength is required to use large means, as well as to accumulate them. It is inevitable to wealth that it shall be put to some sort of use, for without investment it dies. By scattered investment wealth loses personal force. The American Association, in the conservative interests of learning, proposes certain effective investments in science. If it be not given to every plodding worker to be a promoter of discovery, such, at all events, is the privilege of wealth under the authority of this Association. If it be not the good fortune of every investigator to reach knowledge that is new, there are, every year, in every section of this body, workers of whom it is clear that they would reach some discovery of merit if only the means of work could be granted them. Whosoever supplies the means fairly deserves and will receive a share in the results. It is quite with justice that the name of Elizabeth Thompson, the first of the patrons, has been associated with some twenty-one modest determinations of merit recognized by this Association.

“To procure for the labors of scientific men increased facilities” is one of the constitutional objects of this body. It is time for effectiveness towards this object. The Association has established its character for sound judgment, for good working organization, and for representative public interest. It has earned its responsibility as *the American trustee of undertakings in science*.

“To give a stronger . . . impulse . . . to scientific research” is another declaration of what we ought to do. To this end larger endowments are necessary. And it will be strange if some clear-seeing man or woman does not put ten thousand dollars, or some multiple of it, into the charge of this body for some searching experimental inquiry now waiting for the material aid. The committee upon endowment is ready for consultation upon all required details.

“To give . . . more systematic direction to scientific research” is likewise stated as one of our objects. To this intent the organization of sections affords opportunities not surpassed. The discussions upon scientific papers give rise to a concord of

competent opinions as to the direction of immediate work. And arrangements providing in advance for the discussion of vital questions, as formally moved at the last meeting, will, in one way or another, point out to suitable persons such lines of labor as will indeed give systematic direction to research.

In conclusion I may mention another, the most happy of the duties of the American Association. It is to give the hand of hospitable fellowship to the several societies who year by year gather with us upon the same ground. Comrades in labor and in refreshment, their efforts reinforce us, their faces brighten our way. May they join us more and more in the companionship that sweetens the severity of art. A meeting of good workers is a remembrance of pleasure, giving its zest to the aims of the year.

## SOME NEW NICKEL MINERALS.

BY DR. STEPHEN H. EMMENS.

I have, of late, had occasion to examine numerous samples of ores from the recently developed mining region known as the Sudbury District in the Province of Ontario, Canada, and in the course of such examination I have met with three nickeliferous minerals that appear to be distinct from any species hitherto described.

### FOLGERITE.

This is found in the Worthington mine, on the Algoma Branch of the Canadian Pacific Railroad, about 30 miles southwest of Sudbury. The mineral deposit here opened up is of a character similar to that usually observed in the mines of the district; that is to say, it consists of a mixture of pyrrhotite and chalcopyrite, forming ore masses of approximately lenticular form and of varying magnitude, imbedded in a greenstone dyke traversing the Huronian rocks that constitute the chief geological features of the region.

The pyrrhotite is in itself nickeliferous to a greater or less degree in every mine of the district, but at the Worthington mine it is found to be associated with a distinct sulphide (Folgerite) carrying a very high percentage of nickel. This sulphide is spoken of by the local miners and newspapers as being *millerite*, but it differs widely from that species. Its chief characteristics are as follows:

Lustre.—Metallic.

Color.—Light bronze-yellow in mass, but almost tin-white when broken up into fine grains.

Specific Gravity.—No determination of the pure mineral has been made, but a fragment associated with adhering pyrrhotite showed a sp. gr. of 4.73.

Hardness.—3.5.

Streak.—Grayish black.

Form.—Massive, with a platy structure. No crystals have as yet been observed.

Fracture, Irregular.—When comminuted the large fragments preserve a platy form while the smaller particles are finely granular. Very brittle.

Heat Reaction.—When the powdered mineral is heated in a closed tube no sublimate is produced.

Solubility.—The mineral dissolves in nitric acid with separation of sulphur and a green solution.

Magnetism.—In large fragments the mineral is non-magnetic. In minute grains it is magnetic. The finely triturated powder is non-magnetic.

Microscopic Appearances—Under both lens and microscope the powdered mineral appears in the form of shining white grains of irregular form, very distinct from the shining spicules of a light brass-yellow color which constitute the powder of true millerite.

Chemical Analysis.—The specimens analysed were magnetically separated from the accompanying pyrrhotite and gave the following results:

	A	B	C
Nickel .....	35.20	31.45	29.78
Iron .....	33.70	31.01	26.89
Sulphur.....	31.10	37.54	43.33
	<hr/> 100.00	<hr/> 100.00	<hr/> 100.00

Specimen A consisted of platy fragments, each one of which was tested separately with the magnet. Specimens B and C were separated in the form of a coarse powder from the accompanying pyrrhotite, and probably still contained some adhering particles of that mineral. In the cases of B and C the analysis was conducted by first roasting the mineral and then fusing with potassium bisulphate, followed by solution, peroxidation, precipitation of the iron and electrolytic separation of the nickel, all with the usual precautions. In the case of A the raw mineral was dissolved in aqua regia. The sulphur was estimated by difference; and a check determination (by fusion of the raw mineral with sodium carbonate and nitrate and final precipitation as barium sulphate)

for sulphur only, in a fourth sample, gave 34 per cent. It may also be mentioned that specimen A came from the Worthington mine, and that B and C were sent to me with the statement that they came from a deposit at the northeast extremity of the Worthington greenstone dyke. This deposit is distant about  $1\frac{1}{2}$  miles from the Worthington mine and has recently been explored by the Emmens Metal Company; but when Mr. C. T. Mixer, the chemist of that company, paid a visit of inspection to the workings, the person in charge who had sent me the specimens in question could not point out the place whence he had taken them and could not show any further occurrence of the mineral *in situ*. It is probable, therefore, that A, B and C all came from the Worthington mine.

The formula corresponding with the above mentioned analyses is  $\text{Ni Fe S}_2$ , which corresponds to

Nickel .....	32.87
Iron .....	31.30
Sulphur .....	35.83
	<hr/>
	100.00

This composition is between  $\text{Ni S}$  (*Millerite*) and  $\text{Ni Fe}_2 \text{S}_3$  (*Pentlandite*). It is also distinct from that of the "ferriferous polydymite" found at the Vermilion mine, a little to the northeast of the Emmens Company's working, and described by Clarke & Catlett (*American Journal of Science*, 1889, p. 372), as containing 43.18 per cent of nickel, 15.47 per cent. of iron and 41.35 per cent. of sulphur, and as approximating, therefore, to the formula  $\text{Ni}_3 \text{Fe S}_5$ .

I have named this mineral *Folgerite* after Commodore W. M. Folger, the Chief of the Bureau of Ordnance in the U. S. Navy Department, in recognition of that distinguished officer's achievements in the utilization of nickel steel.

#### BLUEITE.

This mineral has for some time past puzzled the Sudbury miners, who have locally dubbed it "Jack's Tin." It is found in several mines of that district and notably at the working of the



Emmens Metal Company, where it is found associated with niccolite, gersdorffite, pyrrhotite and chalcopyrite in the outcrop of a quartz vein cutting the before mentioned greenstone dyke.

The following are the characteristics of the mineral:

Luster.—Metallic, somewhat silky.

Color.—Pale olive-gray, inclining to bronze.

Specific Gravity.—4.2.

Hardness.—3 to 3.5.

Streak.—Black.

Form, Massive.—No crystals have as yet been observed.

Fracture.—Sub-conchoidal, irregular. Brittle.

Heat Reaction.—When the powdered mineral is heated in a closed tube a sublimate of sulphur is produced.

Solubility.—The mineral dissolves readily in nitric acid without separation of sulphur and yields a yellow solution.

Magnetism.—The mineral is non-magnetic.

Microscopic Appearance.—Under the lens the powdered mineral appears to be composed of irregular grains of a dull gray color. Under the microscope the color appears a dull grayish black and the particles are seen to be finely granular without any crystalline form.

Chemical analysis :

Nickel .....	3.5
Iron .....	38.8
Sulphur (by difference) .....	52.3
Insoluble .....	5.4
	<hr/>
	100.00

After deduction of the insoluble matter (gangue) the figures for the mineral become

Nickel .....	3.70
Iron .....	41.01
Sulphur .....	55.29
	<hr/>
	100.00

The sulphur is probably too high, as, owing to the character of the gangue, a portion of this latter may have entered into solution.

The formula  $\text{Fe}_{12} \text{NiS}_{26}$  ( $= (\text{Fe}, \text{Ni}) \text{S}_2$  where  $\text{Fe}:\text{Ni} = 12:1$ ) corresponds with the foregoing analysis, the figures of such formula being :

Nickel .....	3.76
Iron .....	42.96
Sulphur .....	53.28
	<hr/>
	100.00

The considerable percentage of nickel (a very rare element in pyrite) and the easy solubility in nitric acid without separation of sulphur seem to preclude this mineral from being considered merely as a nickeliferous variety of pyrite or marcasite. I have named it *Blueite*, after Mr. Archibald Blue, late Secretary of the Royal Commission appointed to investigate the Mineral Resources of Ontario, and now Director of the Bureau of Mines of that Province.

#### WHARTONITE:

This mineral was brought to me by Mr. C. T. Mixer from a mine situated about seven miles northeast of Sudbury and about two miles from the Blezard mine, worked by the Dominion Mineral Company. It has been known locally as the Shepherd mine, and is of a character similar to the general mines of the district.

The following are the characteristics of the mineral :

Lustre.—Metallic.

Color.—Bronze-yellow.

Streak.—Black.

Form.—Cellular ; the cavities being lined with minute cubic crystals, and the intermediate substance being finely granular. This structure precludes the specific gravity and hardness from being determined with precision. A large piece showed a sp. gr. of 3.73 and a hardness of 4.

Fracture, Irregular.—Brittle.

Heat Reactions.—A sublimate of sulphur in a closed tube and fumes of  $\text{SO}_2$  in an open tube. A sulphur flame is observed on heating a fragment held in forceps.

Solubility.—The mineral is soluble in  $\text{HNO}_3$  with separation of sulphur and a greenish yellow solution.

Magnetism.—On comminution about 10 per cent. of the mineral is found to be magnetic.

Microscopic Appearance.—Under both lens and microscope the powdered mineral is seen to consist of grayish black grains of irregular form and finely granular structure, with occasional minute cubic crystals.

Chemical analysis :

Nickel.....	5.40
Iron.....	42.90
Sulphur.....	45.00
Insoluble.....	4.80
	<hr/>
	98.10

After deduction of the gangue these figures give :

Nickel.....	5.79
Iron.....	45.98
Sulphur.....	48.23
	<hr/>
	100.00

Separate determinations of iron and sulphur were made in the magnetic and non-magnetic constituents respectively with the following results :

	Mag.	Non-Mag.	
Iron.....	66.55	40.4	} plus a little gangue.
Sulphur.....	7.00	52.6	

and a qualitative examination showed that the nickel was clearly with the non-magnetic portion.

The inference deducible from these observations is that the mineral is a mixture of a nickel-iron-disulphide with some magnetite ; and taking the proportion of this latter as being 10 per cent. we have for the composition of the other constituent :

Nickel.....	6.27
Iron.....	41.44
Sulphur.....	52.29
	<hr/>
	100.00

This corresponds to the formula  $\text{Fe}_7 \text{Ni S}_{16}$  or  $(\text{Fe}, \text{Ni}) \text{S}_2$ , in which  $\text{Fe} : \text{Ni} = 7 : 1$ , and of which the figures are :

Nickel .....	6.10
Iron .....	40.68
Sulphur .....	53.22
	<hr/>
	100.00

It may be that this non-magnetic mineral is in part composed of pyrite, in which case the formula will require modification. The aggregate, however, is distinguished by its form and nickeliferous character from pyrite and marcasite.

I have named this mineral *Whartonite*, after Mr. Joseph Wharton of Camden, N. J., in recognition of that gentleman's eminence as the head of the nickel industry in America.

NICKEL AND NICKEL-IRON SULPHIDES IN GENERAL.

For the purpose of indicating the relations of all the known nickel and nickel-iron sulphides to each other, the following table may be found useful :

NAME.	Percentage constitution.			Molecular constitution.			
	Ni.	Fe.	S.	Ni S.	Ni S <sub>2</sub> .	Fe S.	Fe S <sub>2</sub> .
Millerite .....	64.72	-----	35.28	1	--	--	--
Polydymite .....	59.47	-----	40.53	3	1	--	--
Beyrichite .....	57.90	-----	42.10	2	1	--	--
Ferriferous Polydymite	44.92	14.26	40.82	3	--	--	1
Folgerite .....	32.87	31.30	35.83	1	--	1	--
Pentlandite .....	22.03	41.95	36.02	1	--	2	--
Horbachite .....	11.24	42.81	45.95	1	1	1	1
Inverarite .....	10.44	49.72	39.84	1	--	4	1
Whartonite .....	6.10	40.68	53.22	--	1	--	7
Blueite .....	3.76	42.96	53.28	--	1	--	12

It remains to be added that the analyses of the new minerals herein described were made by Mr. C. T. Mixer, and that specimens of Folgerite, Blueite and Whartonite accompany this paper for exhibition to the meeting.

## THE USE OF FLUORIDES IN THE MANUFACTURE OF ALCOHOL.

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BY DR. LEO BAEKELAND.

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Dr. Effront's researches on the antiseptic properties of fluorine compounds have lately received important applications in the alcohol industry and a condensed statement upon this subject may be of interest not only to alcohol manufacturers but also to the biological chemist.

It is a known fact that for the transformation of starch into maltose and dextrine by the action of diastase, the most favorable temperature is from 50° to 60° C. At any lower temperature, the action of the diastase becomes slower, while a higher temperature has a destructive effect upon this soluble ferment which at 80° C. completely loses its saccharifying power.

In laboratory experiments where pure starch and pure diastase can be used it is possible to exclude all secondary influences from other ferments. In practice however, conditions are far different; the raw materials (malt, grain, corn, potatoes, etc.), introduce other ferments which have a very disturbing influence. Already during the germination of the grain we notice that beside the useful diastase, a certain quantity of organic acid is developed. But this is only the beginning of the trouble for we see this acidity increasing during all the following operations, from the making of the sweet wort to the end of the alcoholic fermentation. This acidity is due chiefly to the formation of lactic and butyric acids which are the result of the activity of well specified micro-organisms, the lactic and butyric ferments, the latter being more specially known as *Clortridium Cutyricum*. If a small quantity of lactic acid seems to be favorable to a healthy development of yeast cells, a too large quantity of this acid is useless if not harmful, and any quantity of butyric acid is decidedly injurious to the *enzymotic* action of the diastase as well as to the alcoholic fermentation.

Alcohol manufacturers are very cautious to avoid acidification as they know that the yield of alcohol is smaller in proportion to the increasing acidity of their wort or mash.

The ferments which develop these acids are particularly active at a temperature from 50° C. to 60° C. This means that just that temperature which is most favorable for the diastatic action of the malt will also allow the acid ferments to show their harmful action and to develop the largest quantity of lactic and butyric acid. At a higher temperature however, the action of butyric and lactic ferments is paralyzed, and this is the reason why in making sweet wort a temperature is selected whereby the development of acidity is retarded and by which the diastase does not lose too much of its power. But this means a loss of malt on account of the weakening of the power of the diastase contained in it.

The injurious action of this higher temperature on the diastase is not limited to this; facts have proven that diastase which has been submitted to a high temperature, if only for a moment, has been irremediably injured in regard to its future properties; it will not keep its enzymotic action as long as it would if it had been kept in healthy conditions. This fact is very important if we recollect that the saccharification of the wort is never complete and that the diastase is expected to continue its action during the whole period of alcoholic fermentation in order to saccharify the last quantities of starch left in the wort. Other means have been tried in order to combat the butyric and lactic baccilli and the use of sulphuric and muriatic acids, sulphites and other antiseptics have been proposed. None of them has proved of great advantage; they all show an injurious effect upon the diastatic action of the malt, and the activity of the alcohol ferment.

Hydrofluoric acid or soluble fluorides on the contrary, when used in very small doses prevent the development of butyric and lactic acid and are completely harmless to the diastase or to the alcoholic ferment. Furthermore, such small quantities of fluoride instead of injuring the diastase seem to excite its activity and preserve its power for quite a longer period than when used alone. Experiments have shown that by addition of a small quantity of fluoride, diastase could be kept in action during seven days, and at the end of

this period 80% of the original quantity of diastase was still active, while without the use of fluorides the quantity of active diastase is reduced to 12% at the end of the same period.

No other antiseptics or mineral acids show these preserving qualities when added to diastase. Mineral acids, for instance, when used, even in very moderate quantities have killed the whole of the diastase after five days.

A first advantage of the use of small quantities of fluorides is thus to save malt, of which less need be brought in operation, still giving the same result as larger quantities when used without fluorides. This malt will have a more free and more complete action, and this action will be continued for a longer time on account of the antiseptic properties of fluorides, development of organic acids will be prevented and the wort can be kept nearer between 50° C. and 60° C., which is the temperature at which diastase is most active and where its enzymotic powers are best kept up.

The addition of fluorides have rendered possible the use of malt of very inferior quality with surprising results.

The same beneficial effect of hydrofluoric acid or its salts is observed during the alcoholic fermentation which thereby becomes more regular and more complete.

The fermentation keeps up with about the same intensity during the whole period until all the saccharine matter has been converted into alcohol. The liquid finally proves to be far less acid than if no fluoride is used. The practical result of all this, is a larger yield of alcohol and a better product. If small quantities of fluoride have a beneficial effect on diastase and alcoholic ferment, the contrary result is obtained if larger quantities of fluorine compounds are used. An addition of 25 grammes of commercial hydrofluoric acid (30%) per hectolitre of wort proved very injurious to the action of the diastase even at temperatures as low as 30° C. At higher temperatures, 55° C. for instance, this injurious effect was already produced by 6 or 7 grammes of hydrofluoric acid per hectolitre. Very concentrated or very acid worts have proved especially sensitive to large quantities of hydrofluoric acid.

The same bad effects of an excess of hydrofluoric acid are shown in the alcoholic fermentation which in some cases may be entirely

stopped by it. Soluble fluorides however, even when used a little in excess, are less violent in regard to this. All this shows that if we have in fluorides a sure and powerful destroyer of useless ferments, this agent should be used judiciously as any excess of it may prove detrimental to the expected results.

It would be out of the question to give a general recipe for the quantities of hydrofluoric acid or fluorides which should be used, this depends on too many conditions such as quality of material, temperature of mashing, concentration or acidity of the wort. For instance, quantities of fluoride which may be advantageous in a wort of average concentration and at a low temperature may become injurious in a more concentrated wort, or if kept at a higher temperature.

In every instance where the fluoride process is introduced in a distillery, some preliminary testing has to be done in regard to this before the best effects are obtained.

The destructive action of fluorides on butyric baccilli in the mash can be easily observed by the aid of the microscope. (See *Das Flüssigkeits Verfahren in die Spiritusfabrikation*. by Prof. Dr. Maerker.—Berlin, Verlag von Paul Parey.)

The chemical effect of fluorides is better demonstrated by the following experiment: (See Soxhlet. *Zeitschrift des Landwirths-Vereins in Bayern*, July, 1890) 1000 grammes of crushed corn were boiled with four litres water and the resulting starch heated in a digester (autoclave) at 3 atm. pressure during one hour. The resulting liquid was cooled off to 50° C. and then 80 grammes of dry malt were added and the saccharification kept on at this temperature for about 30 minutes. The resulting sweet wort was divided into two equal portions. To one portion 150 milligrammes of ammonium fluoride were added (corresponding to 6 grammes per hectolitre) and the other portion was left as it was. Both portions were kept constantly at 30° C. After two days the wort without fluoride had considerably thickened and was full of gas bubbles while the other portion which contained fluoride remained entirely clear and liquid.



A comparative analytical examination of both liquids showed :

	No fluoride.	Fluoride.
<i>Degrees saccharometer</i> .....	13.30	13.60
<i>Maltose</i> .....	10.12	11.61
<i>Dextrine</i> .....	2.07	1.07
<i>Acidity</i> (Normal soda solution } per 100 c. c. wort)	8.15	3.9

In another series of experiments wort was prepared in the same way, but after being cooled off to 30° C., 3 grammes of yeast per liter were added. This mixture was put in several bottles which were provided with a hydraulic stopper and which could be kept at a temperature of 30° To the contents of some of these bottles a previous addition of fluoride had been made in quantities equivalent to 6 grammes per hectolitre of wort. After three days, fermentation was complete in all the bottles and the comparative analysis showed:

	No fluoride.	Fluoride. (6 gr. per hectolitre)
<i>Alcohol</i> .....	6.4	7.2
<i>Acidity</i> (Normal soda } per 100 c. c.)	5.6	4.0

The proportion of alcohol in the above results is about 12.5% higher in the sample where fluoride has been used. (See also Effront. *Action des acides minéraux dans la saccharification par le malt et la fermentation des matières amylacées.*—*Moniteur Scientifique* 1890.) (Maerker, *Flussäure verfahren*, loc. cit.)

The specific action of fluorides on the development and activity of yeast cells has been the object of other interesting experiments. (See Effront. *Moniteur Scientifique*. November 1891.—Also Maerker, loc. cit.) An addition of small quantities of fluoride say in 30 milligrammes per 100 c. c., is favorable to the development or increase of the number of yeast cells. Larger quantities (70 to 150 mgs.) decrease the formation of new yeast cells and when as much as 250 to 300 mgrms. per 100 c. c. are used, the development of new yeast cells is practically interrupted. But even then when such large quantities of fluoride are used, the ferment itself is not killed, it

has merely suspended the reproductive faculties of the yeast cells, while their alcohol making action is still existant but with lessened activity. Furthermore if such yeast heated previously with relatively large quantities of fluoride is brought into fresh wort containing no fluoride it will at once resume its full vital properties, new yeast cells will be produced and the alcoholic fermentation will be very energetic.

In some experiments small quantities of yeast (0.25 to 0.25 grm. per 500 c. c.) were added to sweet wort made with corn and left to develop with different quantities of fluoride, and afterwards the relative number of yeast cells was determined in each of the samples with the following results:

	Acidity (c. c. normal soda).	Relative number of yeast cells.
No fluoride - - - - -	1.10	331
0.02 Amm. fluor. - - - - -	0.80	449
0.07 " - - - - -	0.90	381
0.15 " - - - - -	0.70	208

A certain quantity of each of these samples has been added to a fresh wort containing no fluoride (500 c. c. of each sample to 1 kilogr. of wort, 17.4 Sacch.) and after the fermentation was finished the quantity of alcohol produced by the sample was

	Alcohol.
No fluoride - - - - -	4.1%
0.02 grm. amm. fluor - - - - -	7.1
0.07 " - - - - -	8.4 (!)
0.15 " - - - - -	8.5 (!)

The above results show clearly that even by starting with a smaller number of yeast cells, more alcohol has been produced and this is on account of the increased vital powers of these yeast cells after they have been under influence of fluoride.

The specific action of fluorides is not the same on all varieties of yeast. Four kinds of yeast have been especially examined in this direction.

- Saccharomyces Cerevisiæ.*
- " *Pastorianus I.*
- " *Carlsberg.*
- " *Bourton.*

By addition of 100 mgrms. of fluoride to 100 c. c. of liquid the following results have been observed:

	Decrease of development of yeast cells by addition of 100 mgrms. fluoride.	Decrease in production of alcohol by addition of 100 mgrms. fluoride.
<i>S. Pastorianus</i> .....	34%	41%
— <i>Bourton</i> .....	31%	14%
— <i>Carlsberg</i> .....	25%	13%
— <i>Cerevisiæ</i> .....	9%	4%

This shows that *S. Pastorianus* is most sensitive to an addition of 100 mgrms. fluoride, the quantity of alcohol decreases to 41% of what can be produced without fluoride. *S. Bourton* and *S. Carlsberg* are less sensitive but the most resisting of all is *S. Cerevisiæ*. By addition of 300 mgrms. of fluoride the production of new yeast cells is nearly completely stopped in the four varieties but even then *S. Cerevisiæ* gives about three times as much alcohol as *S. Pastorianus* (See table.)

Number of sample.	Name of yeast.	Fluoride per 100 c. c. mgrms.	Number of yeast cells.	Alcohol %
1 } .....	<i>Pastorianus I</i> .....	0	23	7.3
2 } .....		100	15	4.3
3 } .....		150	8	2.6
4 } .....		200	7	2.4
5 } .....		300	2	1.7
6 } .....	<i>Bourton</i> .....	0	32	7.9
7 } .....		100	22	6.8
8 } .....		150	20	5.8
9 } .....		200	10	4.1
10 } .....		300	3	4.0
11 } .....	<i>Carlsberg</i> .....	0	16	6.8
12 } .....		100	12	5.9
13 } .....		150	10	5.6
14 } .....		200	6	5.2
15 } .....		300	2	2.3
16 } .....	<i>Cerevisiæ</i> .....	0	22	7.1
17 } .....		100	20	6.8
18 } .....		150	11	5.2
19 } .....		200	4	4.9
20 } .....		300	2	4.5

The difference in the resisting power of these four varieties of yeast to the action of fluorides can be used to separate one from another. For instance, if a mixture of equal parts of *S. Pastorianus* and *S. Bourton* (whose cells are easily to be distinguished under the microscope) is kept during 72 hours in a wort containing 300 mgrms. of fluoride per 100 c. c. and afterwards transferred to a wort containing no fluoride where they are allowed to ferment during 48 hours, and if these operations are repeated three times, it is possible to eliminate entirely all yeast cells of the *Pastorianus* variety.

It is to be noted as an important fact that yeast can be kept for more than six months with an addition of 200 to 300 mgrms. of fluoride per 100 c. c. Even after this time the yeast cells have proved to be in an excellent state of preservation and when brought afterwards in a wort without fluoride they developed rapidly and produced a splendid fermentation.

The practical results which have been obtained in distilleries, after Effront's process have fully demonstrated the remarkably useful properties of fluorides. In Europe nearly all important distilleries have adopted the process and their reports have been very favorable. In general an increase from 8 to 10% in the yield on alcohol has been obtained, and a more steady and more complete fermentation has been noticed. The production of lactic and butyric acid has been reduced to a minimum. The quality of alcohol has also improved and this is probably due to the prevention of secondary fermentations. The odor and taste of such alcohol is very similar to that of ordinary alcohol that has been filtered over charcoal.

From the beginning when the fluoride process was introduced into distilleries special experiments have been made in order to see if the presence of small quantities of these salts in the slops or wash did not have unhealthy effect on the cattle using such food. Dr. Tappeiner (*Zeitschrift des Landwirth's Vereins in Bayern*, 1890) has published some interesting laboratory experiments which show clearly that not the smallest difference has been observed in the use of such slops, either in the composition of the milk nor the general conditions of the animals fed upon it.

**Magnetism.**—On comminution about 10 per cent. of the mineral is found to be magnetic.

**Microscopic Appearance.**—Under both lens and microscope the powdered mineral is seen to consist of grayish black grains of irregular form and finely granular structure, with occasional minute cubic crystals.

**Chemical analysis :**

Nickel.....	5.40
Iron.....	42.90
Sulphur.....	45.00
Insoluble.....	4.80
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	98.10

After deduction of the gangue these figures give :

Nickel.....	5.79
Iron.....	45.98
Sulphur.....	48.23
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	100.00

Separate determinations of iron and sulphur were made in the magnetic and non-magnetic constituents respectively with the following results :

	Mag.	Non-Mag.	
Iron.....	66.55	40.4	} plus a little gangue.
Sulphur.....	7.00	52.6	

and a qualitative examination showed that the nickel was clearly with the non-magnetic portion.

The inference deducible from these observations is that the mineral is a mixture of a nickel-iron-disulphide with some magnetite; and taking the proportion of this latter as being 10 per cent. we have for the composition of the other constituent :

Nickel.....	6.27
Iron.....	41.44
Sulphur.....	52.29
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	100.00

This corresponds to the formula  $\text{Fe}_7 \text{Ni S}_{16}$  or  $(\text{Fe}, \text{Ni}) \text{S}_2$ , in which  $\text{Fe} : \text{Ni} = 7 : 1$ , and of which the figures are :

Nickel .....	6.10
Iron .....	40.68
Sulphur .....	53.22
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100.00	

It may be that this non-magnetic mineral is in part composed of pyrite, in which case the formula will require modification. The aggregate, however, is distinguished by its form and nickeliferous character from pyrite and marcasite.

I have named this mineral *Whartonite*, after Mr. Joseph Wharton of Camden, N. J., in recognition of that gentleman's eminence as the head of the nickel industry in America.

NICKEL AND NICKEL-IRON SULPHIDES IN GENERAL.

For the purpose of indicating the relations of all the known nickel and nickel-iron sulphides to each other, the following table may be found useful :

NAME.	Percentage constitution.			Molecular constitution.			
	Ni.	Fe.	S.	Ni S.	Ni S <sub>2</sub> .	Fe S.	Fe S <sub>2</sub> .
Millerite .....	64.72	-----	35.28	1	--	--	--
Polydymite .....	59.47	-----	40.53	3	1	--	--
Beyrichite .....	57.90	-----	42.10	2	1	--	--
Ferriferous Polydymite	44.92	14.26	40.82	3	--	--	1
Folgerite .....	32.87	31.30	35.83	1	--	1	--
Pentlandite .....	22.03	41.95	36.02	1	--	2	--
Horbachite .....	11.24	42.81	45.95	1	1	1	1
Inverarite .....	10.44	49.72	39.84	1	--	4	1
Whartonite .....	6.10	40.68	53.22	--	1	--	7
Blueite .....	3.76	42.96	53.28	--	1	--	12

It remains to be added that the analyses of the new minerals herein described were made by Mr. C. T. Mixer, and that specimens of Folgerite, Blueite and Whartonite accompany this paper for exhibition to the meeting.

# THE USE OF FLUORIDES IN THE MANUFACTURE OF ALCOHOL.

BY DR. LEO BAEKELAND.

Dr. Effront's researches on the antiseptic properties of fluorine compounds have lately received important applications in the alcohol industry and a condensed statement upon this subject may be of interest not only to alcohol manufacturers but also to the biological chemist.

It is a known fact that for the transformation of starch into maltose and dextrine by the action of diastase, the most favorable temperature is from 50° to 60° C. At any lower temperature, the action of the diastase becomes slower, while a higher temperature has a destructive effect upon this soluble ferment which at 80° C. completely loses its saccharifying power.

In laboratory experiments where pure starch and pure diastase can be used it is possible to exclude all secondary influences from other ferments. In practice however, conditions are far different; the raw materials (malt, grain, corn, potatoes, etc.), introduce other ferments which have a very disturbing influence. Already during the germination of the grain we notice that beside the useful diastase, a certain quantity of organic acid is developed. But this is only the beginning of the trouble for we see this acidity increasing during all the following operations, from the making of the sweet wort to the end of the alcoholic fermentation. This acidity is due chiefly to the formation of lactic and butyric acids which are the result of the activity of well specified micro-organisms, the lactic and butyric ferments, the latter being more specially known as *Clortridium Cutyricum*. If a small quantity of lactic acid seems to be favorable to a healthy development of yeast cells, a too large quantity of this acid is useless if not harmful, and any quantity of butyric acid is decidedly injurious to the *enzymotic* action of the diastase as well as to the alcoholic fermentation.

Alcohol manufacturers are very cautious to avoid acidification as they know that the yield of alcohol is smaller in proportion to the increasing acidity of their wort or mash.

The ferments which develop these acids are particularly active at a temperature from 50° C. to 60° C. This means that just that temperature which is most favorable for the diastatic action of the malt will also allow the acid ferments to show their harmful action and to develop the largest quantity of lactic and butyric acid. At a higher temperature however, the action of butyric and lactic ferments is paralyzed, and this is the reason why in making sweet wort a temperature is selected whereby the development of acidity is retarded and by which the diastase does not lose too much of its power. But this means a loss of malt on account of the weakening of the power of the diastase contained in it.

The injurious action of this higher temperature on the diastase is not limited to this; facts have proven that diastase which has been submitted to a high temperature, if only for a moment, has been irremediably injured in regard to its future properties; it will not keep its enzymotic action as long as it would if it had been kept in healthy conditions. This fact is very important if we recollect that the saccharification of the wort is never complete and that the diastase is expected to continue its action during the whole period of alcoholic fermentation in order to saccharify the last quantities of starch left in the wort. Other means have been tried in order to combat the butyric and lactic baccilli and the use of sulphuric and muriatic acids, sulphites and other antiseptics have been proposed. None of them has proved of great advantage; they all show an injurious effect upon the diastatic action of the malt, and the activity of the alcohol ferment.

Hydrofluoric acid or soluble fluorides on the contrary, when used in very small doses prevent the development of butyric and lactic acid and are completely harmless to the diastase or to the alcoholic ferment. Furthermore, such small quantities of fluoride instead of injuring the diastase seem to excite its activity and preserve its power for quite a longer period than when used alone. Experiments have shown that by addition of a small quantity of fluoride, diastase could be kept in action during seven days, and at the end of



this period 80% of the original quantity of diastase was still active, while without the use of fluorides the quantity of active diastase is reduced to 12% at the end of the same period.

No other antiseptics or mineral acids show these preserving qualities when added to diastase. Mineral acids, for instance, when used, even in very moderate quantities have killed the whole of the diastase after five days.

A first advantage of the use of small quantities of fluorides is thus to save malt, of which less need be brought in operation, still giving the same result as larger quantities when used without fluorides. This malt will have a more free and more complete action, and this action will be continued for a longer time on account of the antiseptic properties of fluorides, development of organic acids will be prevented and the wort can be kept nearer between 50° C. and 60° C., which is the temperature at which diastase is most active and where its enzymotic powers are best kept up.

The addition of fluorides have rendered possible the use of malt of very inferior quality with surprising results.

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The fermentation keeps up with about the same intensity during the whole period until all the saccharine matter has been converted into alcohol. The liquid finally proves to be far less acid than if no fluoride is used. The practical result of all this, is a larger yield of alcohol and a better product. If small quantities of fluoride have a beneficial effect on diastase and alcoholic ferment, the contrary result is obtained if larger quantities of fluorine compounds are used. An addition of 25 grammes of commercial hydrofluoric acid (30%) per hectolitre of wort proved very injurious to the action of the diastase even at temperatures as low as 30° C. At higher temperatures, 55° C. for instance, this injurious effect was already produced by 6 or 7 grammes of hydrofluoric acid per hectolitre. Very concentrated or very acid worts have proved especially sensitive to large quantities of hydrofluoric acid.

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stopped by it. Soluble fluorides however, even when used a little in excess, are less violent in regard to this. All this shows that if we have in fluorides a sure and powerful destroyer of useless ferments, this agent should be used judiciously as any excess of it may prove detrimental to the expected results.

It would be out of the question to give a general recipe for the quantities of hydrofluoric acid or fluorides which should be used, this depends on too many conditions such as quality of material, temperature of mashing, concentration or acidity of the wort. For instance, quantities of fluoride which may be advantageous in a wort of average concentration and at a low temperature may become injurious in a more concentrated wort, or if kept at a higher temperature.

In every instance where the fluoride process is introduced in a distillery, some preliminary testing has to be done in regard to this before the best effects are obtained.

The destructive action of fluorides on butyric baccilli in the mash can be easily observed by the aid of the microscope. (See *Das Flüsssäure Verfahren in die Spiritusfabrikation*. by Prof. Dr. Maerker.—Berlin, Verlag von Paul Parey.)

The chemical effect of fluorides is better demonstrated by the following experiment: (See Soxhlet. *Zeitschrift des Landwirths-Vereins in Bayern*, July, 1890) 1000 grammes of crushed corn were boiled with four litres water and the resulting starch heated in a digester (autoclave) at 3 atm. pressure during one hour. The resulting liquid was cooled off to 50° C. and then 80 grammes of dry malt were added and the saccharification kept on at this temperature for about 30 minutes. The resulting sweet wort was divided into two equal portions. To one portion 150 milligrammes of ammonium fluoride were added (corresponding to 6 grammes per hectolitre) and the other portion was left as it was. Both portions were kept constantly at 30° C. After two days the wort without fluoride had considerably thickened and was full of gas bubbles while the other portion which contained fluoride remained entirely clear and liquid.

Emmens Metal Company, where it is found associated with niccolite, gersdorffite, pyrrhotite and chalcopyrite in the outcrop of a quartz vein cutting the before mentioned greenstone dyke.

The following are the characteristics of the mineral:

Luster.—Metallic, somewhat silky.

Color.—Pale olive-gray, inclining to bronze.

Specific Gravity.—4.2.

Hardness.—3 to 3.5.

Streak.—Black.

Form, Massive.—No crystals have as yet been observed.

Fracture.—Sub-conchoidal, irregular. Brittle.

Heat Reaction.—When the powdered mineral is heated in a closed tube a sublimate of sulphur is produced.

Solubility.—The mineral dissolves readily in nitric acid without separation of sulphur and yields a yellow solution.

Magnetism.—The mineral is non-magnetic.

Microscopic Appearance.—Under the lens the powdered mineral appears to be composed of irregular grains of a dull gray color. Under the microscope the color appears a dull grayish black and the particles are seen to be finely granular without any crystalline form.

Chemical analysis :

Nickel .....	3.5
Iron .....	38.8
Sulphur (by difference) .....	52.3
Insoluble .....	5.4
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	100.00

After deduction of the insoluble matter (gangue) the figures for the mineral become

Nickel .....	3.70
Iron .....	41.01
Sulphur .....	55.29
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	100.00

The sulphur is probably too high, as, owing to the character of the gangue, a portion of this latter may have entered into solution.

The formula  $\text{Fe}_{12} \text{NiS}_{26}$  ( $= (\text{Fe}, \text{Ni}) \text{S}_2$  where  $\text{Fe}:\text{Ni} = 12:1$ ) corresponds with the foregoing analysis, the figures of such formula being :

Nickel .....	3.76
Iron .....	42.96
Sulphur .....	53.28
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	100.00

The considerable percentage of nickel (a very rare element in pyrite) and the easy solubility in nitric acid without separation of sulphur seem to preclude this mineral from being considered merely as a nickeliforous variety of pyrite or marcasite. I have named it *Blueite*, after Mr. Archibald Blue, late Secretary of the Royal Commission appointed to investigate the Mineral Resources of Ontario, and now Director of the Bureau of Mines of that Province.

#### WHARTONITE:

This mineral was brought to me by Mr. C. T. Mixer from a mine situated about seven miles northeast of Sudbury and about two miles from the Blezard mine, worked by the Dominion Mineral Company. It has been known locally as the Shepherd mine, and is of a character similar to the general mines of the district.

The following are the characteristics of the mineral :

Lustre.—Metallic.

Color.—Bronze-yellow.

Streak.—Black.

Form.—Cellular ; the cavities being lined with minute cubic crystals, and the intermediate substance being finely granular. This structure precludes the specific gravity and hardness from being determined with precision. A large piece showed a sp. gr. of 3.73 and a hardness of 4.

Fracture, Irregular.—Brittle.

Heat Reactions.—A sublimate of sulphur in a closed tube and fumes of  $\text{SO}_2$  in an open tube. A sulphur flame is observed on heating a fragment held in forceps.

Solubility.—The mineral is soluble in  $\text{HNO}_3$  with separation of sulphur and a greenish yellow solution.

Magnetism.—On comminution about 10 per cent. of the mineral is found to be magnetic.

Microscopic Appearance.—Under both lens and microscope the powdered mineral is seen to consist of grayish black grains of irregular form and finely granular structure, with occasional minute cubic crystals.

Chemical analysis :

Nickel .....	5.40
Iron .....	42.90
Sulphur .....	45.00
Insoluble .....	4.80
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	98.10

After deduction of the gangue these figures give :

Nickel .....	5.79
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Separate determinations of iron and sulphur were made in the magnetic and non-magnetic constituents respectively with the following results :

	Mag.	Non-Mag.	
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and a qualitative examination showed that the nickel was clearly with the non-magnetic portion.

The inference deducible from these observations is that the mineral is a mixture of a nickel-iron-disulphide with some magnetite ; and taking the proportion of this latter as being 10 per cent. we have for the composition of the other constituent :

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This corresponds to the formula  $\text{Fe}_7 \text{Ni S}_{16}$  or  $(\text{Fe}, \text{Ni}) \text{S}_2$ , in which  $\text{Fe} : \text{Ni} = 7 : 1$ , and of which the figures are :

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It may be that this non-magnetic mineral is in part composed of pyrite, in which case the formula will require modification. The aggregate, however, is distinguished by its form and nickeliferous character from pyrite and marcasite.

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For the purpose of indicating the relations of all the known nickel and nickel-iron sulphides to each other, the following table may be found useful :

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Polydymite .....	59.47	-----	40.53	3	1	--	--
Beyrichite .....	57.90	-----	42.10	2	1	--	--
Ferriferous Polydymite	44.92	14.26	40.82	3	--	--	1
Folgerite .....	32.87	31.30	35.83	1	--	1	--
Pentlandite .....	22.03	41.95	36.02	1	--	2	--
Horbachite .....	11.24	42.81	45.95	1	1	1	1
Inverarite .....	10.44	49.72	39.84	1	--	4	1
Whartonite .....	6.10	40.68	53.22	--	1	--	7
Blueite .....	3.76	42.96	53.28	--	1	--	12

It remains to be added that the analyses of the new minerals herein described were made by Mr. C. T. Mixer, and that specimens of Folgerite, Blueite and Whartonite accompany this paper for exhibition to the meeting.

# THE USE OF FLUORIDES IN THE MANUFACTURE OF ALCOHOL.

BY DR. LEO BAEKELAND.

Dr. Effront's researches on the antiseptic properties of fluorine compounds have lately received important applications in the alcohol industry and a condensed statement upon this subject may be of interest not only to alcohol manufacturers but also to the biological chemist.

It is a known fact that for the transformation of starch into maltose and dextrine by the action of diastase, the most favorable temperature is from 50° to 60° C. At any lower temperature, the action of the diastase becomes slower, while a higher temperature has a destructive effect upon this soluble ferment which at 80° C. completely loses its saccharifying power.

In laboratory experiments where pure starch and pure diastase can be used it is possible to exclude all secondary influences from other ferments. In practice however, conditions are far different; the raw materials (malt, grain, corn, potatoes, etc.), introduce other ferments which have a very disturbing influence. Already during the germination of the grain we notice that beside the useful diastase, a certain quantity of organic acid is developed. But this is only the beginning of the trouble for we see this acidity increasing during all the following operations, from the making of the sweet wort to the end of the alcoholic fermentation. This acidity is due chiefly to the formation of lactic and butyric acids which are the result of the activity of well specified micro-organisms, the lactic and butyric ferments, the latter being more specially known as *Clortridium Cutyricum*. If a small quantity of lactic acid seems to be favorable to a healthy development of yeast cells, a too large quantity of this acid is useless if not harmful, and any quantity of butyric acid is decidedly injurious to the *enzymotic* action of the diastase as well as to the alcoholic fermentation.

Alcohol manufacturers are very cautious to avoid acidification as they know that the yield of alcohol is smaller in proportion to the increasing acidity of their wort or mash.

The ferments which develop these acids are particularly active at a temperature from 50° C. to 60° C. This means that just that temperature which is most favorable for the diastatic action of the malt will also allow the acid ferments to show their harmful action and to develop the largest quantity of lactic and butyric acid. At a higher temperature however, the action of butyric and lactic ferments is paralyzed, and this is the reason why in making sweet wort a temperature is selected whereby the development of acidity is retarded and by which the diastase does not lose too much of its power. But this means a loss of malt on account of the weakening of the power of the diastase contained in it.

The injurious action of this higher temperature on the diastase is not limited to this ; facts have proven that diastase which has been submitted to a high temperature, if only for a moment, has been irremediably injured in regard to its future properties ; it will not keep its enzymotic action as long as it would if it had been kept in healthy conditions. This fact is very important if we recollect that the saccharification of the wort is never complete and that the diastase is expected to continue its action during the whole period of alcoholic fermentation in order to saccharify the last quantities of starch left in the wort. Other means have been tried in order to combat the butyric and lactic baccilli and the use of sulphuric and muriatic acids, sulphites and other antiseptics have been proposed. None of them has proved of great advantage ; they all show an injurious effect upon the diastatic action of the malt, and the activity of the alcohol ferment.

Hydrofluoric acid or soluble fluorides on the contrary, when used in very small doses prevent the development of butyric and lactic acid and are completely harmless to the diastase or to the alcoholic ferment. Furthermore, such small quantities of fluoride instead of injuring the diastase seem to excite its activity and preserve its power for quite a longer period than when used alone. Experiments have shown that by addition of a small quantity of fluoride, diastase could be kept in action during seven days, and at the end of



this period 80% of the original quantity of diastase was still active, while without the use of fluorides the quantity of active diastase is reduced to 12% at the end of the same period.

No other antiseptics or mineral acids show these preserving qualities when added to diastase. Mineral acids, for instance, when used, even in very moderate quantities have killed the whole of the diastase after five days.

A first advantage of the use of small quantities of fluorides is thus to save malt, of which less need be brought in operation, still giving the same result as larger quantities when used without fluorides. This malt will have a more free and more complete action, and this action will be continued for a longer time on account of the antiseptic properties of fluorides, development of organic acids will be prevented and the wort can be kept nearer between 50° C. and 60° C., which is the temperature at which diastase is most active and where its enzymotic powers are best kept up.

The addition of fluorides have rendered possible the use of malt of very inferior quality with surprising results.

The same beneficial effect of hydrofluoric acid or its salts is observed during the alcoholic fermentation which thereby becomes more regular and more complete.

The fermentation keeps up with about the same intensity during the whole period until all the saccharine matter has been converted into alcohol. The liquid finally proves to be far less acid than if no fluoride is used. The practical result of all this, is a larger yield of alcohol and a better product. If small quantities of fluoride have a beneficial effect on diastase and alcoholic ferment, the contrary result is obtained if larger quantities of fluorine compounds are used. An addition of 25 grammes of commercial hydrofluoric acid (30%) per hectolitre of wort proved very injurious to the action of the diastase even at temperatures as low as 30° C. At higher temperatures, 55° C. for instance, this injurious effect was already produced by 6 or 7 grammes of hydrofluoric acid per hectolitre. Very concentrated or very acid worts have proved especially sensitive to large quantities of hydrofluoric acid.

The same bad effects of an excess of hydrofluoric acid are shown in the alcoholic fermentation which in some cases may be entirely

stopped by it. Soluble fluorides however, even when used a little in excess, are less violent in regard to this. All this shows that if we have in fluorides a sure and powerful destroyer of useless ferments, this agent should be used judiciously as any excess of it may prove detrimental to the expected results.

It would be out of the question to give a general recipe for the quantities of hydrofluoric acid or fluorides which should be used, this depends on too many conditions such as quality of material, temperature of mashing, concentration or acidity of the wort. For instance, quantities of fluoride which may be advantageous in a wort of average concentration and at a low temperature may become injurious in a more concentrated wort, or if kept at a higher temperature.

In every instance where the fluoride process is introduced in a distillery, some preliminary testing has to be done in regard to this before the best effects are obtained.

The destructive action of fluorides on butyric baccilli in the mash can be easily observed by the aid of the microscope. (See *Das Flüssäure Verfahren in die Spiritusfabrikation*. by Prof. Dr. Maerker.—Berlin, Verlag von Paul Parey.)

The chemical effect of fluorides is better demonstrated by the following experiment: (See Soxhlet. *Zeitschrift des Landwirths-Vereins in Bayern*, July, 1890) 1000 grammes of crushed corn were boiled with four litres water and the resulting starch heated in a digester (autoclave) at 3 atm. pressure during one hour. The resulting liquid was cooled off to 50° C. and then 80 grammes of dry malt were added and the saccharification kept on at this temperature for about 30 minutes. The resulting sweet wort was divided into two equal portions. To one portion 150 milligrammes of ammonium fluoride were added (corresponding to 6 grammes per hectolitre) and the other portion was left as it was. Both portions were kept constantly at 30° C. After two days the wort without fluoride had considerably thickened and was full of gas bubbles while the other portion which contained fluoride remained entirely clear and liquid.

A comparative analytical examination of both liquids showed :

	No fluoride.	Fluoride.
<i>Degrees saccharometer</i> .....	13.30	13.60
<i>Maltose</i> .....	10.12	11.61
<i>Dextrine</i> .....	2.07	1.07
<i>Acidity</i> (Normal soda solution } per 100 c. c. wort)	8.15	3.9

In another series of experiments wort was prepared in the same way, but after being cooled off to 30° C., 3 grammes of yeast per liter were added. This mixture was put in several bottles which were provided with a hydraulic stopper and which could be kept at a temperature of 30° To the contents of some of these bottles a previous addition of fluoride had been made in quantities equivalent to 6 grammes per hectolitre of wort. After three days, fermentation was complete in all the bottles and the comparative analysis showed:

	No fluoride.	Fluoride. (6 gr. per hectolitre)
<i>Alcohol</i> .....	6.4	7.2
<i>Acidity</i> (Normal soda } per 100 c. c.)	5.6	4.0

The proportion of alcohol in the above results is about 12.5% higher in the sample where fluoride has been used. (See also Effront. *Action des acides minéraux dans la saccharification par le malt et la fermentation des matières amylacées.*—*Moniteur Scientifique* 1890.) (Maerker, *Flussäure verfahren*, loc. cit.)

The specific action of fluorides on the development and activity of yeast cells has been the object of other interesting experiments. (See Effront. *Moniteur Scientifique*. November 1891.—Also Maerker, loc. cit.) An addition of small quantities of fluoride say in 30 milligrammes per 100 c. c., is favorable to the development or increase of the number of yeast cells. Larger quantities (70 to 150 mgs.) decrease the formation of new yeast cells and when as much as 250 to 300 mgrms. per 100 c. c. are used, the development of new yeast cells is practically interrupted. But even then when such large quantities of fluoride are used, the ferment itself is not killed, it

has merely suspended the reproductive faculties of the yeast cells, while their alcohol making action is still existant but with lessened activity. Furthermore if such yeast heated previously with relatively large quantities of fluoride is brought into fresh wort containing no fluoride it will at once resume its full vital properties, new yeast cells will be produced and the alcoholic fermentation will be very energetic.

In some experiments small quantities of yeast (0.25 to 0.25 gm. per 500 c. c.) were added to sweet wort made with corn and left to develop with different quantities of fluoride, and afterwards the relative number of yeast cells was determined in each of the samples with the following results:

	Acidity (c. c. normal soda).	Relative number of yeast cells.
No fluoride . . . . .	1.10	331
0.02 Amm. fluor. . . . .	0.80	449
0.07 " . . . . .	0.90	381
0.15 " . . . . .	0.70	208

A certain quantity of each of these samples has been added to a fresh wort containing no fluoride (500 c. c. of each sample to 1 kilogr. of wort, 17.4 Sacch.) and after the fermentation was finished the quantity of alcohol produced by the sample was

	Alcohol.
No fluoride . . . . .	4.1%
0.02 gm. amm. fluor. . . . .	7.1
0.07 " . . . . .	8.4 (!)
0.15 " . . . . .	8.5 (!)

The above results show clearly that even by starting with a smaller number of yeast cells, more alcohol has been produced and this is on account of the increased vital powers of these yeast cells after they have been under influence of fluoride.

The specific action of fluorides is not the same on all varieties of yeast. Four kinds of yeast have been especially examined in this direction.

- Saccharomyces Cerevisiæ.*
- “ *Pastorianus I.*
- “ *Carlsberg.*
- “ *Bourton.*

By addition of 100 mgrms. of fluoride to 100 c. c. of liquid the following results have been observed:

	Decrease of development of yeast cells by addition of 100 mgrms. fluoride.	Decrease in production of alcohol by addition of 100 mgrms. fluoride.
<i>S. Pastorianus</i> .....	34%	41%
— <i>Bourton</i> .....	31%	14%
— <i>Carlsberg</i> .....	25%	13%
— <i>Cerevisiæ</i> .....	9%	4%

This shows that *S. Pastorianus* is most sensitive to an addition of 100 mgrms. fluoride, the quantity of alcohol decreases to 41% of what can be produced without fluoride. *S. Bourton* and *S. Carlsberg* are less sensitive but the most resisting of all is *S. Cerevisiæ*. By addition of 300 mgrms. of fluoride the production of new yeast cells is nearly completely stopped in the four varieties but even then *S. Cerevisiæ* gives about three times as much alcohol as *S. Pastorianus* (See table.)

Number of sample.	Name of yeast.	Fluoride per 100 c. c. mgrms.	Number of yeast cells.	Alcohol %
1 } .....	<i>Pastorianus I</i>	0	23	7.3
2 } .....		100	15	4.3
3 } .....		150	8	2.6
4 } .....		200	7	2.4
5 } .....		300	2	1.7
6 } .....	<i>Bourton</i>	0	32	7.9
7 } .....		100	22	6.8
8 } .....		150	20	5.8
9 } .....		200	10	4.1
10 } .....		300	3	4.0
11 } .....	<i>Carlsberg</i>	0	16	6.8
12 } .....		100	12	5.9
13 } .....		150	10	5.6
14 } .....		200	6	5.2
15 } .....		300	2	2.3
16 } .....	<i>Cerevisiæ</i>	0	22	7.1
17 } .....		100	20	6.8
18 } .....		150	11	5.2
19 } .....		200	4	4.9
20 } .....		300	2	4.5

The difference in the resisting power of these four varieties of yeast to the action of fluorides can be used to separate one from another. For instance, if a mixture of equal parts of *S. Pastorianus* and *S. Bourton* (whose cells are easily to be distinguished under the microscope) is kept during 72 hours in a wort containing 300 mgrms. of fluoride per 100 c. c. and afterwards transferred to a wort containing no fluoride where they are allowed to ferment during 48 hours, and if these operations are repeated three times, it is possible to eliminate entirely all yeast cells of the *Pastorianus* variety.

It is to be noted as an important fact that yeast can be kept for more than six months with an addition of 200 to 300 mgrms. of fluoride per 100 c. c. Even after this time the yeast cells have proved to be in an excellent state of preservation and when brought afterwards in a wort without fluoride they developed rapidly and produced a splendid fermentation.

The practical results which have been obtained in distilleries, after Effront's process have fully demonstrated the remarkably useful properties of fluorides. In Europe nearly all important distilleries have adopted the process and their reports have been very favorable. In general an increase from 8 to 10% in the yield on alcohol has been obtained, and a more steady and more complete fermentation has been noticed. The production of lactic and butyric acid has been reduced to a minimum. The quality of alcohol has also improved and this is probably due to the prevention of secondary fermentations. The odor and taste of such alcohol is very similar to that of ordinary alcohol that has been filtered over charcoal.

From the beginning when the fluoride process was introduced into distilleries special experiments have been made in order to see if the presence of small quantities of these salts in the slops or wash did not have unhealthy effect on the cattle using such food. Dr. Tappeiner (*Zeitschrift des Landwirth's Vereins in Bayern*, 1890) has published some interesting laboratory experiments which show clearly that not the smallest difference has been observed in the use of such slops, either in the composition of the milk nor the general conditions of the animals fed upon it.

Since then practice has entirely confirmed these conclusions. The slops produced from distilleries working with fluoride is far less acid than usual and is remarkable for its keeping qualities. While, usually, slop becomes acid very quickly, it will, on the contrary, keep for weeks without much alteration if fluorides are used. Its taste is sweeter, also, and this is probably the reason why in some cases where the fluoride process has been introduced, it took the cattle a few days before being accustomed to this taste. It should be reported however that in one case when the slop was used over again in the mashing process the fluorides seemed to accumulate in it and therefore it is thought advisable not to use the same slop more than twice if it has to be used afterward for feeding purposes.

## A PECULIAR REACTION OF THE NIAGARA RIVER WATER.

BY DR. EDWARD GUEDEMAN.

The water supply of the City of Buffalo is taken from the Niagara River, about one mile from its source, Lake Erie. The inlet where the water is drawn, is about one-quarter of a mile from the shore, and the river at that point has a six to eight mile current.

The water is generally clear, but after every severe rain storm, or from high winds, it becomes turbid and then contains quite an amount of suspended matter, which filtration will separate.

The water contains, per United States gallon, from eleven to fifteen grains of total solids, five to eight grains being organic. The inorganic portion consists mainly of calcium carbonate and sulphate.

From December, 1891, to August, 1892, the water, as taken from the mains, gave an absolutely neutral reaction. During August a sudden change took place, the water becoming alkaline. The amount of alkalinity varies; 100 c. c. of water being sufficient to neutralize from 0.05–0.3 c. c. of half normal sulphuric acid. The water gives a strong reaction for carbonic acid, and this reaction is, without doubt, due to the calcium bicarbonate contained in the water. The water loses this alkaline reaction by filtration through animal charcoal.

The distilled water made from the Niagara River water, gives a distinct *acid* reaction.

The acid in 100 c. cm. of the distilled water will neutralize from 0.01–0.5 c. c. of half normal caustic potash solution.

The water before being distilled was made alkaline with caustic soda, sodium carbonate, caustic baryta and barium carbonate; still the distillate gave the same acid reaction as the original untreated water. The water was made acid with sulphuric acid without any effect on the distillate. Potassium permanganate also



gave no better results. The water was filtered through animal charcoal, then distilled, without any effect on the acidity of the distillate.

The amount of acidity varies constantly, but, so far, has always come within the above mentioned limits, the average being about 0.15 c. c. of half normal potash solution to 100 c. c. of distilled water.

It makes no difference whether the distillation is carried on in copper or glass retorts; whether the heat is applied by means of steam coils or bunsen burners.

The separate portions from the same distillation show no marked difference in acidity, the first 100 c. c. of distillate neutralizing as much potash solution as last. The water remaining in the retort gives the same reaction, neutral or alkaline, as the original water. This would tend to show that the acid is not contained in the water as such, but is a product of decomposition, continuously formed during ebullition.

The distilled water gave no reaction for carbonic acid and leaves absolutely no residue on evaporation. It reacts acid to solutions of litmus, lakmoid and alkaline phenolphthalein.

The water can easily be purified from this acid body by boiling off about one-fourth of its bulk, when the remainder will be neutral. A second distillation, after having made the water alkaline with sodium carbonate, also gives a neutral distillate.

To be absolutely certain that this acid reaction was not due to some local contamination, I requested Prof. H. M. Hill, of the University of Buffalo, and Dr. J. A. Miller, of the Niagara University, to test the water as delivered at their respective laboratories, the one being about one mile and the other about two miles from my laboratory, and all supplied from different water mains. Both gentlemen obtained the characteristic acid reaction from their distilled waters.

These tests were begun in December, 1891, and are still being carried on.

BUFFALO, N. Y., July, 1892.

## NOTE ON THE RECOVERY OF ARSENIC.

BY ALBERT B. PRESCOTT.

A few years ago I gave a report of some results as to the limits of recovery in a few chemical separations,\* arsenic being one of the bodies under trial. It was one of the purposes of that report to show that there are limits to the extent of recovery in good chemical separations. In respect to arsenic, as  $\text{As}_2\text{O}_3$ , it was found that "the loss in separating from an avoirdupois pound of tissue substances, is, in round terms, about a thousand times the quantity needed for identification." This quantity, the least capable of sure identification by every good operator in every trial, was placed at 0.0000025 gram (a quarter of a hundredth of a milligram.). In the analyses from which these results were drawn, three several methods of concentration of the arsenic were used, in comparison with each other, but in all of them the final estimation was by weight of the elemental arsenic reduced from hydrogen arsenide, in the mirror by Marsh's method. When the arsenic was taken in a pure aqueous solution of standard strength, the recovery was very close. This method—the Berzelius-Marsh method—has lately been very carefully examined by Charles R. Sanger,† and reported with a very full history of this plan of analysis from its earliest literature. Having used the mirror method of estimating arsenic for a good many years, and directed its quantitative use by students, I desired to make a note upon certain features of the operation.

(1.) In all cases let the further end of the reduction tube be

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\* "Control Analyses and Limits of Recovery," 1885: *Proc. Am. Assoc. Adv. Sci.*, **34**, 109; *Chem. News*, **53**, 78. Citing Holthöffer and Prescott, *Contributions Chem. Lab. Univ., Mich.*, 1883, II., 87. Also, Hubbard, *Ibid*, 1882, I., 12.

† "The Quantitative Determination of Arsenic by the Berzelius-Marsh Process, especially as applied to the Analyses of Wall Papers and Fabrics." 1891: *Am. Chem. Jour.*, **13**, 431.

bent vertically downward and carried into solution of silver nitrate, through which the gas is to bubble from the beginning to the end of the operation. This gives the best possible security against incomplete reduction of the arsenic from the gas at any period of its flow. And it gives a convenient indication of the rate of flow of the gas. The test of the flame of the escaping gas, for spots upon cold porcelain, is necessarily a brief and fitful test, incapable of that uninterrupted control required for close results whether quantitative or qualitative. The silver solution test is a severe one, and a dark stain of the end of the delivery tube after the gas has passed for one to two hours is not an indication of waste of arsenic. The organic dust of the air upon the surface of the silver solution, with the action of the light, is usually sufficient to give a perceptible silver stain after an hour or two. Special precaution of seclusion, and of freedom from laboratory vapors, can be taken if necessary. The test, however, with reasonable interpretation, is an effectual one, and, what is necessary in the quantitative operation, it excludes hydrogen sulphide, as well as the arsenide, in the gas beyond the seat of the mirror. To draw out the reduction tube for delivery into the silver solution, draw a second time, so as to have two narrowed portions of considerable length almost continuous with each other. Cut the tube at the extremity of the further narrowed portion, and then bend at right angles between the two narrowed portions. The delivery end will then be so light as hardly to need support for itself, but it is well to provide a rest at the bend.

(2.) The reduction tube is heated best through a wrap of copper gauze. This should be four to five inches long, wide enough to fully enclose the tube, and bound snugly and evenly with a wire from the edge of the gauze. The wrap should reach to the narrowed part if the narrowing be gradual, or to seven or eight millimeters from the narrowed part if that be sudden. In fact, however, the wrap should be adjusted after the mirror begins to form, so as to place the mirror at the right part of the narrowed tube, in proportion to the depth of the mirror. A heavy mirror may need to be carried back to the full width of the tube. The wrap serves a double purpose. It equalizes the temperature around the tube

and from one end of the heated portion to the other, and this is the greater advantage. It is a mechanical support, and this is desirable for even good hard glass in a two hours' heating. If the reduction tube be as wide as many advise, the wrap should be longer. I prefer a reduction tube of not over about six millimeters internal diameter, requiring not so high a heat for reduction. Then a single bunsen burner with bat-wing top is sufficient for supplying the heat.

I may mention other particulars, admitting of different personal preference. For a drying tube I use calcium chloride as surely neutral in reaction as though it were in a carbon and hydrogen estimation. I prefer the zinc to be coarsely granulated and previously prepared with a very slight charge, a mere trace, of platinum deposit. I do not use a generator distinct from the reduction flask. The arsenical solution is introduced from a graduated tube or a weighed container, through a valved thistle tube dipping into the generating liquid, and at the end washed down with water, and, from time to time, enough dilute acid is added to keep the gas going through the silver solution at an even and not too rapid rate. The reduction tube is not heated until the air is well out of the apparatus, avoiding water of combustion, and the arsenical liquid is introduced from half an hour to an hour and a half after the beginning of the operation, according to what is in hand. At the end of the operation, the gas is continued through the silver solution for as much as a quarter of an hour after flame has been removed and the reduction tube become cold. Undoubtedly arsenic is liable to be deposited in some state upon the zinc while the reduction is going on rapidly, but that the arsenic is continuously carried out in gas until it has been all removed is evidenced by the results.

UNIVERSITY OF MICHIGAN, August, 1892.

## THE ALKALOIDS OF SABADILLA.

BY RICHARD FISCHER.\*

Although considerable work has been done by different chemists and pharmacists on the alkaloids of sabadilla seed (*Asagraea officinalis*), still the results obtained have been so contradictory in many respects, that the real character of these alkaloids is as yet unknown. With the view of isolating the various alkaloids if possible, and to try the effect of different ways of extraction of the drug, I entered upon the following work :

The presence of an alkaloid in sabadilla seed was first discovered in 1819 by Meissner, and at about the same time, but independently of him, by Pelletier and Caventon. The latter obtained the alkaloid in the form of an amorphous base (or rather mixture) by boiling the seeds in water acidulated with sulphuric acid and precipitating the aqueous extract with ammonia.

Conerbe, in 1834, isolated from a mixture so obtained three distinct substances, of which one was amorphous, but yielded a crystallizable sulphate and hydrochlorate. It was readily soluble in alcohol or ether, but insoluble in water. To this alkaloid Conerbe gave the name veratrine. The second alkaloid, called by him sabadilline, was insoluble in ether, but soluble in alcohol and water, and crystallizable therefrom. The third was also soluble in alcohol and water, insoluble in ether, was amorphous, and formed non-crystalline salts ; it was regarded by him as the mono-hydrate of sabadilline.

In 1855, Merck obtained from commercial veratrine, by evaporation of a solution in diluted alcohol, a very pure substance which he succeeded in crystallizing. This body, to which he applied the term veratrine, gave upon analysis numbers leading to the formula  $C_{32} H_{52} N_2 O_8$ . Its salts, with the exception of the auro-chloride, failed to crystallize.

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\* Communicated by Albert B. Prescott.

- Weigelin, in 1871, separated three alkaloids from sabadilla seeds, of which the one identical with Merck's base, he considers as capable of existing in two different forms, one soluble and the other insoluble in water. The other two alkaloids were obtained by shaking with fusel oil, in the aqueous extract from which ammonia had precipitated the first base.

In 1877, Schmidt and Köppen obtained a crystallizable base from *Asagraea officinalis*, for which they gave the formula  $C_{32}H_{50}NO_9$ . They agree with Weigelin in his conclusion that veratrine can exist in a soluble and an insoluble variety.

In 1878, Wright and Luff, in an extensive research published in the JOURNAL OF THE CHEMICAL SOCIETY for that year, found three distinct alkaloids: Firstly, an amorphous base, termed by them veratrine, which furnishes a crystallizable sulphate and hydrochlorate. Secondly, the crystalline alkaloid previously described by Merck, Weigelin and Schmidt and Köppen, but for which they propose the term cevadine. They regard its composition as  $C_{32}H_{49}NO_9$ . Thirdly, cevadilline, an amorphous base, insoluble in ether, but differing in other respects from the alkaloid previously described by Weigelin under that name. The method of extraction of the seeds, as used by these investigators, was, in short, as follows: The coarsely powdered seeds were percolated with alcohol, acidulated with tartaric acid, the percolate was evaporated to a small bulk, the resin precipitated with water and the alkaloids finally precipitated with an alkali and shaken out with ether.

Since then, Bosetti, in 1883, after working on commercial veratrine, concluded that this consists of two isomeric modifications of the same alkaloid,  $C_{32}H_{49}NO_9$ . The first of these (Wright and Luff's cevadine) is crystalline, almost insoluble in water, but readily soluble in alcohol or ether. For this he retains Merck's name, veratrine. The second modification is soluble in water. For this he proposes the name veratridine.

Later than this, I have found hardly any literature on the subject. In the work done I have proceeded as follows:

Two kilos. of the coarsely powdered seeds were macerated for two weeks with 95% alcohol, after which they were expressed; the residue was then packed in a percolator and extracted with alcohol.

The percolate was mixed with the portion expressed and the whole divided into two parts, half of which was evaporated on the water bath while the rest was allowed to evaporate spontaneously with the purpose of seeing whether or not there would be any difference in the yield.

After concentrating the solution to the consistency of a syrup, it was poured into about ten times its volume of acidulated water, when a large quantity of resin and oil separated out. The aqueous solution was then rendered alkaline with sodium carbonate (which I found would precipitate the alkaloid much more readily than ammonia) and repeatedly shaken out with ether, the ethereal solution being agitated with a dilute solution of sulphuric acid and used over again. The acid solution of alkaloids was again precipitated with sodium carbonate and re-dissolved in ether, when, upon separating and spontaneous evaporation of the ether, a resin-like, amber colored mass was left, easily pulverizable, and almost white when powdered. This residue seemed identical with the mass left upon evaporation of an ethereal solution of Merck's so-called "crystalline veratrine."

The alkaloidal mixture so obtained was found to be readily soluble in ether, alcohol, chloroform, amyl alcohol and methyl alcohol, almost insoluble in water, and but slightly soluble in petroleum benzine, the part dissolved out in the latter case being found to be identical with the residue, as subsequent additions of the same quantity of solvents dissolved out exactly the same amounts. It responded to all the tests of the U. S. Ph. for veratrine, such as dissolving in hot hydrochloric acid with a blood-red color, and giving a strong greenish-yellow fluorescence when triturated in a mortar with concentrated sulphuric acid, which color soon passes to a reddish-yellow and finally to an intense scarlet.

Upon dissolving a part of the mass in alcohol and allowing it to evaporate spontaneously, a portion separated out on the sides of the beaker in colorless, transparent masses which under the microscope were of a decided crystalline structure, though not distinct crystals.

Upon dissolving another portion in ether and adding petroleum benzine a precipitate was formed. I therefore added enough

petroleum benzine (previously diluted to prevent too great precipitation) until a very slight cloudiness appeared and allowed the mixture to evaporate spontaneously. The residue for a large part consisted of small, colorless, transparent, bead-like masses, which, when broken up, presented a crystalline appearance, and which I considered as quite pure cevadine (Merck's veratrine). They responded to the same tests as the mixture and perfectly neutralized acids but the salts failed to crystallize. Upon adding auric chloride to the hydrochloric acid solution of the alkaloid, a heavy yellow precipitate formed, almost insoluble in water but readily soluble in alcohol, from which, however, it failed to crystallize. The platinic salt similarly produced was much more readily soluble in water; it, too, failed to crystallize.

I next tried Merck's method for the separation of a crystallizable alkaloid, namely, that of adding enough water to an alcoholic solution of the alkaloidal mixture to cause a slight precipitate, then adding alcohol till this just dissolved and evaporating on the water bath at 50–60° C. A fine white precipitate soon separated, but it was mixed with so much of a resin-like substance as to make it impossible to obtain it pure. I therefore tried another watery alcoholic solution and allowed it to evaporate spontaneously. In a few days, quite large quantities of a substance separated in the form of shining scales, which appeared crystalline under the microscope, and which I think is identical with Merck's veratrine.

The amount of crystalline alkaloids obtained by all of these processes was, however, too small to allow of an elementary analysis.

The resin-like mass left after the separation of the crystalline principle could not be obtained pure enough to warrant the belief that it really is one alkaloid, as it has been regarded by Wright and Luff, who named it veratrine.

In the hope of obtaining Wright and Luff's cevadilline, I shook out with amyl alcohol the alkaline extract from which ether would remove no more alkaloid, and evaporated off the amyl alcohol on the water bath, when a brownish-yellow mass remained, insoluble in ether, but readily soluble in alcohol and slightly, so in water. Upon solution in a small quantity of acidulated



water, and subsequent addition of an excess of sodium carbonate, quite a heavy white, flocculent precipitate was formed, which, after filtering out, was found to be perfectly soluble in a large quantity of water, but could be obtained almost pure white upon washing with ether, in which it is practically insoluble. It was found to be precipitated by the general reagents for alkaloids, but the quantity obtained was too small to admit of any further researches. Wright and Luff in their investigations obtained the brownish residue mentioned above, but did not succeed in obtaining a white alkaloid.

The second portion of the alcoholic extract was treated as follows: After allowing it to evaporate spontaneously to the consistence of a syrup, it was added to about ten times its volume of acidulated water, the aqueous solution was separated from the oil and resin, and the alkaloids precipitated by sodium carbonate. They were then filtered out, washed on the filter until the filtrate ran through colorless, and dried at a gentle heat. The product was a perfectly white powder, for the greater part soluble in ether, the residue being of a yellow color and appearing to be extractive matter that had not been washed out. The soluble portion acted exactly like the substance described above.

To try the effect of extracting the drug with acidulated alcohol, two kilos. of the powdered seeds were extracted in exactly the same manner as described in the previous process, using, however, alcohol containing 0.5% of sulphuric acid as a menstruum. Upon evaporating off the alcohol and precipitating the resin with water, a great difference in the amount of oil separating out was noticed, for while by the former process about 10% was obtained, the yield by the latter did not exceed three per cent.

The alkaloids were now extracted from their aqueous solution, as in the previous process, with the exception that the final ethereal solution was again shaken out with acidulated water, precipitated with sodium carbonate, the precipitate collected and washed on a filter and dried at a gentle heat.

The white alkaloidal powder thus produced, seemed in no way to differ from the products of the other methods and by repeating the processes of evaporation from various solvents the same crystalline residues were formed.

The amount of alkaloids obtained was about the same for either method, varying from seventeen to twenty grms. per kilo. or almost two per cent., which is a much larger yield than I have seen reported by any previous investigator, Wright and Luff obtaining only 0.6%, while Conerbe, Schmidt and Köppen and several others obtained one per cent.

With regard to the term *veratrine*, different authors use it to represent altogether different substances, thereby causing considerable confusion. Thus, the term is used by the U. S. Ph. to represent the mixture of alkaloids as prepared from *sabadilla* seed. Conerbe, who first investigated the composition of this mixture, applied the name *veratrine* to an amorphous alkaloid; later, Merck applied it to his crystalline alkaloid, and this term was used quite generally until Wright and Luff named the crystalline alkaloid *cevadine*, and mentioned an amorphous alkaloid under the name *veratrine*, claiming priority on account of Conerbe's researches. The terms *cevadine*, *veratrine* and *cevadilline* as used by these latter investigators, have been adopted in both the United States and National Dispensatories, Maisch's *Materia Medica*, Beilstein's "*Organische Chemie*," and several other books, while Richter's *Organic Chemistry* still applies the name *veratrine* to Merck's base, and mentions *cevadine* as identical with it.

In conclusion, to summarize my results in this work, I would say that for extracting the drug, I regard the use of any acid whatsoever in the menstruum as entirely superfluous; and extraction by percolation to be the most satisfactory, as long maceration and expression and subsequent percolation, though perhaps just as thorough, takes up much more time with no visible advantages. The use of heat (the temperature of the water bath) in evaporating off the alcohol seems to be without objection, and has the advantage that the alcohol can be recovered.

With regard to the yield of total alkaloids, it seems to me that the amount usually stated is too low, for although I did not attempt a quantitative estimation, yet the results obtained by ordinary procedure warrant me in coming to the above decision. Whether this difference is due to a superior quality of drug in my case, or to a difference in the method of extraction, I am unable

to state. It appeared to me, however, that the method of extraction with ether would be preferable, for by it I obtained a larger yield, because in washing the precipitate according to the other method considerable goes into solution. Besides this, the product obtained in the former case is much purer and the method, for that reason alone, deserves preference.

Concerning the chemical composition of commercial veratrine, I accomplished practically nothing on account of lack of time. The great difficulty is in obtaining alkaloids pure enough, because all but one are amorphous and the presence of even a minute quantity of amorphous alkaloid prevents the other from crystallizing. The subject is certainly an interesting as well as an important one, and would furnish a large field of work for any investigator.

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*Bosetti*, 1883 : *Archiv. d. Pharm.* [3], 21, 81.  
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UNIVERSITY OF MICHIGAN.

## NOTE ON THE DIRECT OXIDATION OF ORGANIC MATTER IN WATER.

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BY W. P. MASON AND S. K. HINE.\*

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A great difference of opinion has existed among the authorities upon the question of oxidation of organic matter in potable waters.

For instance: Tidy says "I am led to the inevitable conclusion that the oxidation of the organic matter in sewage when mixed with unpolluted water and allowed a certain flow, proceeds with extreme rapidity, and that it is impossible to say how short a distance such a mixture need flow, under favorable conditions before the sewage matter becomes thoroughly oxidized. It is certain to my mind that there is no river in the United Kingdom but what is many times longer than is required to effect the destruction of the sewage by oxidation."

He also says: "It was further evident that the last traces of organic matter were the most difficult to oxidize."

The following is a description of the apparatus which he employed in the experiments which led to the conclusion above quoted.

It consisted of a series of 20 troughs, each 10 ft. long and constructed of two pieces of wood joined together at a right angle and lined with glass. Each trough was so placed that it had a fall of one inch, the water from one trough being discharged into a second placed under, but a few inches distant from it. The fall of this second trough was in the opposite direction to the first, the second trough allowing the water to fall in like manner into a third placed under it, the fall of which was in the same direction as the first and so on and on. By this arrangement a constant flow

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\*The following was presented by Mr. Hine as a graduation thesis for the degree of B. S., at the Rensselaer Polytechnic Institute in June, 1892. The work is entirely his own, and was undertaken at my suggestion and under my observation.—W. P. MASON.

of the water to be experimented upon was obtained through the 20 troughs. At the top of the apparatus a cistern was placed of sufficient size to hold the entire bulk of the water to be employed.

From the cistern a constant flow of the water through the troughs was maintained. A second cistern of similar size was placed at the bottom of the apparatus, so that all the water from the last trough of the series was delivered therein. The water from the lower cistern was continually pumped by a small force pump into the one above.

As opposed to Tidy's conclusions, Frankland states:

"I should say that it is simply impossible that the oxidizing power acting on sewage running in mixture with water over a distance of any length, is sufficient to remove its noxious quality. I presume that the sewage could only come in contact with oxygen from the oxygen contained in the water and also from the oxygen on the surface of the water, and we are aware that ordinary oxygen does not exercise any rapid oxidizing power on organic matter. We know that to destroy organic matter the most powerful oxidizing agents are required. We must boil it with nitric and chloric acid and the most perfect chemical reagents. To think to get rid of organic matter by exposure to the air for a short time is absurd."

One of Frankland's experiments was as follows: A bottle containing an equal volume of peaty water and air was securely tied to a wooden cradle which was fastened to the connecting rod of a horizontal steam engine making 100 strokes per minute and was thus shaken. Frankland afterwards analyzed the air in the bottle, and from lack of  $\text{CO}_2$  therein concluded absence of oxidation.

It was with a view of obtaining more light upon this subject, from analysis of the water itself, that the following experiments were undertaken.

The method of shaking, by fastening to the connecting rod of an engine, was similar to that of Frankland, and the water experimented upon was in each case analyzed before and after shaking. In the first six (6) experiments a tin can of 4000 c.c. capacity was used, but glass stoppered bottles of like capacity were afterwards substituted therefor.

Varying amounts of sewerage were placed in the bottles, water added until the dilution reached 3,000 c.c., the mixture was then thoroughly stirred and 1,500 c.c. were taken out and analyzed. The bottle containing the remaining 1,500 c.c. was then securely fastened to the connecting rod of a horizontal steam engine of 10 in. stroke, running at a speed of 75 revolutions per minute, so that in an hour the water was subjected to 9,000 violent concussions and traveled 1.25 miles.

The lengths of time during which the waters were thus lashed into spray varied from 18 to 60 hours. The mean temperature of the water during the shaking was 30° C.

An examination of the results shows that the amount of oxidation which took place during the agitation of the water was very trifling, a finding entirely in accordance with Prof. Leed's observations of the water of the Niagara river before and after passing Niagara Falls. Direct oxidation does not seem to be a factor of any considerable importance in the purification of polluted water.

## FREE AMMONIA.

	Before Shaking.	After Shaking.	Hours Shaken.
1.....	.145	.180	18
2.....	.130	.140	18
3.....	.420	.450	42
4.....	.310	.350	18
5.....	.205	.410	40
6.....	.205	.195	42
7.....	.840	1.145	42
8.....	.345	.410	18
9.....	.220	.395	18
10.....	.185	.115	18
11.....	.550	.115	18
12.....	.045	.105	13
13.....	.085	.125	21
14.....	.060	.100	23
15.....	.040	.155	60
16.....	.060	.035	18
17.....	.035	.110	18
18.....	.030	.105	21

ORGANIC MATTER IN WATER.

FREE AMMONIA.

	Before Shak-og.	After Shaking.	Hours Shaken.
19 .....	.050	.120	52
20 .....	.105	.130	22
21 .....	.075	.140	19
22 .....	.080	.110	24
23 .....	.080	.125	42
24 .....	.085	.145	42

ALBUMINOID AMMONIA.

	Before Shaking.	After Shaking.	Hours Shaken.
1 .....	.355	.370	18
2 .....	.285	.300	18
3 .....	.455	.400	42
4 .....	.550	.570	18
5 .....	.440	.080	40
6 .....	.180	.115	42
7 .....	.690	.560	42
8 .....	.215	.325	18
9 .....	.410	.440	18
10 .....	.750	.845	18
11 .....	.435	.440	18
12 .....	.490	.440	13
13 .....	.335	.325	21
14 .....	.330	.270	23
15 .....	.345	.300	60
16 .....	.355	.355	18
17 .....	.300	.250	18
18 .....	.270	.320	21
19 .....	.285	.285	52
20 .....	.285	.210	22
21 .....	.255	.225	19
22 .....	.285	.240	24
23 .....	.275	.245	42
24 .....	.290	.250	42

## REQUIRED OXYGEN.

	Before Shaking.	After Shaking.	Hours Shaken.
1.....	4.25	4.75	18
2.....	3.35	4.35	18
3.....	4.15	4.25	42
4.....	4.70	4.15	18
5.....	4.95	1.85	40
6.....	2.80	2.40	42
7.....	5.00	3.90	42
8.....	3.50	3.10	18
9.....	2.50	2.75	18
10.....	9.05	7.90	18
11.....	4.60	3.80	18
12.....	4.20	3.60	13
13.....	3.10	2.95	21
14.....	2.90	2.65	23
15.....	3.60	2.65	60
16.....	3.50	3.50	18
17.....	3.00	2.70	18
18.....	2.85	2.60	21
19.....	2.80	2.40	52
20.....	2.65	2.35	22
21.....	3.75	2.80	19
22.....	3.40	3.55	24
23.....	3.30	3.15	42
24.....	3.10	3.40	42

## NITROGEN IN NITRITES.

	Before Shaking.	After Shaking.	Hours Shaken.
1.....	.001	.007	18
2.....	.012	.018	18
3.....	.012	.037	42
4.....	.012	.011	18
5.....	.007	.036	40
6.....	.003	trace.	42
7.....	.003	.001	42
8.....	.004	.005	18
9.....	.005	.005	18
10.....	trace.	.001	18
11.....	trace.	.001	18
12.....	.005	.004	13
13.....	.004	.008	21
14.....	.007	.008	23
15.....	.007	.002	60



## ORGANIC MATTER IN WATER.

## NITROGEN IN NITRITES.

	Before Shaking.	After Shaking.	Hours Shaken.
16.....	.004	.010	18
17.....	.003	trace.	18
18.....	trace.	trace.	21
19.....	trace.	trace.	52
20.....	.001	.001	22
21.....	.003	.003	19
22.....	.004	.005	24
23.....	.004	.004	42
24.....	.010	.010	42

## NITROGEN IN NITRATES.

	Before. Shaking.	After Shaking.	Hours Shaken.
1.....	1.28	1.25	18
2.....	1.117	1.284	18
3.....	1.126	1.188	42
4.....	1.144	1.100	18
5.....	1.139	1.223	40
6.....	1.073	1.136	42
7.....	0.932	0.220	42
8.....	0.752	0.695	18
9.....	1.179	1.148	18
10.....	1.690	1.306	18
11.....	1.014	1.042	18
12.....	1.000	1.584	13
13.....	1.056	1.210	21
14.....	1.091	1.144	23
15.....	1.196	1.359	60
16.....	1.179	1.245	18
17.....	1.025	1.135	18
18.....	1.293	1.262	21
19.....	0.836	1.038	52
20.....	1.139	1.117	22
21.....	1.342	1.372	19
22.....	1.073	1.223	24
23.....	1.425	1.474	42
24.....	1.509	1.544	42

REGULAR MEETING, October 7th, 1892.

The regular meeting of the Society was held in the Law Lecture Room of the University. Vice-President Breneman in the chair.

The minutes of the Rochester (general) meeting were read and accepted.

The regular order of business was preceded by a discussion upon the subject of the spelling of chemical terms.

Prof. McMurtrie moved that the subject be taken up at the next general meeting. Carried.

Prof. Hale then read the revised constitution as reported by the Committee on Revision.

The meeting was then adjourned.

DURAND WOODMAN,  
*Recording Secretary.*



# AN INDEX TO THE LITERATURE OF STEREOCHEMISTRY,

WITH A NOTE ON THE STEREOCHEMISTRY OF CREATININES.

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BY DR. ARNOLD EILOART.


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In compiling this index I have been much indebted to the numerous references in Van't Hoff-Meyerhoffer's "Stereochemie," most of which, with amplifications and some corrections, are incorporated here; also to the bibliography, by Prof. Warder, of which I have made free use. To Dr. Henry Carrington Bolton my thanks are due for valuable advice as well as for bibliographical data; in particular for calling my attention to Swedenborg's contribution to stereochemistry.

## PLAN OF INDEX.

The bibliography of this subject published two years ago by Warder having been classified according to subjects, I have arranged the present list in the order of the authors' names, hoping that thus the maximum benefit may accrue from the existence of both indexes, which may be used together. But in order that this index may be capable of independent use as a guide to the literature of any given branch of the subject a symbol is prefixed to each paper, excepting only those of scope too wide to admit of such brief indication of their subject matter. A list of symbols precedes the list of papers.

For clearness, only the main subject of each paper has been in-

licated by a symbol; thus a paper marked  may treat not only of ring-configurations but of rings containing an asymmetric carbon-atom (C); yet if ring-configuration is the main subject, the symbol C will not appear.

Whether or not a paper on optical activity bears mainly on the question of the asymmetric carbon-atom is often difficult to decide. For most cases I have settled the question by marking with C only papers which were printed after those of Van't Hoff and Le Bel in 1874. In doing this I have simply accepted as a separate epoch the period which these chemists made such by their work. Earlier papers on the action of substances on polarized light are marked L for "Light."

As the great bulk of stereochemical investigation has been massed together in point of time, a chronological index seemed useless; on the other hand many a reader may wish to consult the literature of a particular period or to see at a glance the general chronological distribution of the literature; the few lines necessary to satisfy such readers have therefore been added in the form of a classification of publications into periods.

Finally, since a specially helpful form of guidance consists in information as to other guides, and since so many must make compactness and not originality the criterion of what they shall read, a list of reviews of the main subject and of its chief branches is given.

## LIST OF SYMBOLS AND CONTRACTIONS.


C = stereochemistry of carbon.

C = asymmetric carbon.

$\begin{array}{c} \text{C} \\ | \text{ for } | \end{array}$  = ethane derivatives.

$\begin{array}{c} \text{C} \\ || \text{ for } || \\ \text{C} \end{array}$  = ethylene derivatives.

$\vee$  for  $\begin{array}{c} \diagup \\ \text{C} \\ \diagdown \end{array}$  = "Cis-trans" isomers.

 = Benzene and derived rings.

L = Action on polarized light.

N = Nitrogen except pentavalent nitrogen.

N<sup>v</sup> = Pentavalent nitrogen.

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Ann. = Ann. Chem. (Liebig.)

Ber. = Ber. d. Chem. Ges.



R. = My review of Stereochemistry.<sup>1</sup>

The figures following R indicate the page or pages of the review on which the reference or references preceding R, and placed in parenthesis with it, are given. This affords a ready means of gaining some idea of the contents of the papers so bracketed.

<sup>1</sup>About to appear independently with this index as an appendix.

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<sup>1</sup> In several instances the references to the *Berichte* given in this index differ from those in the *Berichte* indexes, which contain numerous errors; some of them really *recherchés*.

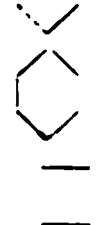
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<sup>1</sup>A special connection between para-atoms (Claus' formula), said to exist side by side with the general central connection among all six atoms.


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- N (Ber. **23**, 1967—R. 47.) Ber. **23**, 1972. Piperazine group.
- | (Ber. **23**, 620, 623, 1464, 3414; **24**, 1041, 1050, 1064, 1074, 1085, 2001.—R. 26, 30-34.) Dynamic isomerism.
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- | “ and Hjelt, E.—1887 and 1888. Ber. **20**, 2988, 3078; **21**, 2089, 2097, 2102; **22**, 67; **23**, 650. Substituted succinic acids.
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- | “ and Mintz, N.—1890. Ber. **23**, 647, 653, 656, 3410. Substituted succinic acids.
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<sup>1</sup>Watts' Dictionary (1863), citing Friedländer, calls the salt lævo-rotatory, and this is repeated in the edition of 1888, although Le Bel had stated in 1877 that it is inactive.

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- 110.— Hausdörfer, A. See Bischoff, C. A.
111. N Hausmann, J.—1890. Ber. **23**, 531. Dioximes of nitrobenzil.
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<sup>1</sup> This paper is of historic importance as being Van't Hoff's first publication on the subject. See R., p. 4.

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$$\begin{array}{c} \text{C}_6\text{H}_5\text{COCOC}_6\text{H}_5 \\ || \\ \text{C}_6\text{H}_5\text{COCOC}_6\text{H}_5 \end{array}$$
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<sup>1</sup> Contains theory that atoms in active molecules must be arranged in enantiomorphous form.



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265. N Schindler, T.—1891. Monatsh. Chem. **12**, 637. (Ref. Ber. **25**, 196.) Crotonaldoxime.
266. || Schmidt, E.—1879 and 1881. Ber. **12**, 252; Ann. **208**, 249. Tiglic and angelic acids.  
C 1888. Ber. **21**, 1829. Hyoscyamine and atropine.
267. C Schmoeger, M.—1892. Ber. **25**, 1452. Milk-sugars.
268. N<sup>v</sup> Schryver, S. B.—1891. J. Chem. Soc. Proc. p. 39. (Ref. Chem. News, **63**, 174.) Two methyl-diethylisoamylammonium iodides.
269. — Schulthess, O. See Michael, A.
270. | Schultz, G.—1878 and '79. Ber. **11**, 216; Ann. **196**, 1. Diphenic acid.




271. C Schulze, E., Barbieri, J. and Bosshard, E.—1885.  
Ztschr. physiol. Chem. **9**, 63.  
C “ and Bosshard, E.—1884. Ber. **17**, 1610.  
Amido-acids.  
1885 and '86. Ber. **18**, 388: Ztschr.  
physiol. Chem. **10**, 134. Leucine and  
glutamic acid “doubled.”  
C “ and Nägeli, E.—1886. Ztschr. physiol. Chem.  
**11**, 201. Phenylamidopropionic acid.
272. — Selden, Ch. C. See Anschütz, R.  
273. — Siegfeld, M. See Auwers, K.  
274. — Silber, P.—1887. Ber. **20**, 2594. Pyrrol derivatives.  
“ See Ciamician, G.
275. — Simmen, C.—1876. “Untersuchungen über die Con-  
stitution der chemischen Elemente und  
deren Verbindungen bei Annahme regel-  
mässiger Anordnung im Raume.” Basle.  
(Ref. Jsb. Chem. 1876, 4.)
276. II Skraup, Z. H.—1891. (Monatsh. Chem. **12**, 107, 146.  
—R. 12, 23.) Compare Tanatar, S.
277. N Smith, A. W.—1892. Ber. **24**, 4025. Ketoximes.  
(Hantzsch's laboratory.)
278. N Söderbaum, H. G.—1891. Ber. **24**, 1215. Dioximido-  
succinic acids.—Ibid 1381.  $\omega$ -Isonitro-  
soacetophenone. (Hantzsch's laboratory.)  
1892. Ber. **25**, 904. Dioximidopropionic  
acids.
279. C Sorokin, B.—1888. J. prakt. Chem. [2] **37**, 320. Con-  
nection between composition and optical  
activity.
280. C Staedel, W.—1878. Ber. **11**, 1752. Crystallisation of  
racemates.
281. — Stahel, R. See Fischer, E.  
282. — Steche, A. See Fischer, E.
283. N Stierlin, R.—1889. Ber. **22**, 376. Isomeric dioximes of  
anisil and paratolil. (V. Meyer's labora-  
tory.)


284. — Stockmeier, H. See Erlenmeyer, E.
285.  Stohmann, F.—1891. Ber. d. k. sächs. Ges. der. Wissensch. p. 635. (Ref. Ber. 25, 496.) Heat of combustion of hexahydrobenzol, etc. A confirmation of Baeyer's strain-theory.
286. || Stolz, F.—1886. Ber. 19, 536.  $\beta$ -iodacrylic acids (p. 542.)
287. C Stone, W. E.—1892. Am. Chem. J. 14, 399. Grape-sugar and its isomers. Review.
288. — Strecker, O. See Kekulé, A.
289. — Strutt, C. E. See Swedenborg, E.
290. — Struve, O. See Ladenburg, J.
291. || Sudborough, J. J. —1892. Ber. 25, 2237. Stilbene series; transformation of isomers. (V. Meyer's laboratory.)
- Svedborg, E. See Swedenborg, E.
292. — Swedenborg, Emmanuel, (or Emanuel), [Svedborg]—1721. "Prodromus principiorum rerum naturalium sive novorum tentaminum chymiam et physicam experimentalem geometrice explicandi." Amsterdam: John Osterwyk, 16mo.
- “ 1727. Second edition. J. and A. Strander Amsterdam.
- “ 1754. Third edition. Hildburghausen, J. G. Harnisch. For notice of this work see Acta Eruditorum, Feb., 1722, pp. 83–87.
- “ 1847. "Some specimens of a work on the Principles of Chemistry with other treatises. Translated from the Latin by Charles Edward Strutt." London: W. Newbery, 8vo, pp. xlii+253, ill. Includes a translation of the work last-mentioned (pp. 1–179), also an introduction by the translator (pp. i–xlii.).
293.  Sworn, S. A.—1889. Phil. Mag. [5] 28, 402, 443. 1890. J. Chem. Soc. 58, 238.

294. — Szymanski, F. See Deichmüller, A.
295. — Tafel, J. See Fischer, E.
296. || Tanatar, S.—1890. Zhurnal Khim. **22**, I, 310. (Ref. Ber. **23**, 433.) Conversion of maleïc into fumaric acid. See Skraup, Z. H.
- | 1891. Ibid. **23**, I, 339. (Ref. Ber. **24**, 970.) Action of water on bromsuccinic acid.
297. C Tesmer, H.—1885. Ber. **18**, 2606; especially p. 2608. Saccharin.
298. C Thomsen, J.—1880. Ber. **13**, 2168, 2264, 2269. Optical activity of carbohydrates.
-  1880-'86. Ber. **13**, 1388, 1808, 2166; **15**, 328; **19**, 2944. Octahedral benzene formula.
299. N Thomson, J. J., and Threlfall, R.—1886. (Proc. Roy. Soc. **40**, 329.—R. 40.)
300. — Threlfall, R. See Thomson, J. J.
301. | Tiemann, F.—1891. Ber. **24**, 3169. Hydrobenzoïns.
- C “ and Haarmann, R.—1886. Ber. **19**, 1257. Isosaccharic acid.
302.  Tilden, W.—1888. J. Chem. Soc. **53**, 879. Terpenes and benzene.
303. | Tillmanns, H.—1890. Ann. **258**, 87. Diphenylsuccinic acid. (Laboratory of Wislicenus.)
304. — Tissot, G. See Michael, A.
305. C Tollens, B.—1880-'86. Ann. **206**, 226; **227**, 228. Ber. **19**, 107. Glucoses.
- “ See Deichmüller, A.
- “ See Günther, A.
- “ See Herrmann, P.
- “ See Wheeler, H. J.
306. — Trapesonzjanz, Ch. See Bischoff, C. A.
307. C Tutton, A. E.—1891. J. Chem. Soc. **59**, 233. Crystalline form of calcium glycerate.
308. N Vaubel, W.—1891. “Das Stickstoffatom.” Giessen E. Ottmann, pp. 8, ill.—Chem. Ztg. **15**, 475. (J. prakt. Chem. [2] **44**, 137.—R. 48.) Ibid. 572. Correction.<sup>1</sup>

<sup>1</sup> The benzene formula published by V. as new is now ascribed to Marsh, “whose paper was not abstracted in the Berichte;” (but see Ref. Ber. **21**, 879.) Marsh's paper was, however, nine months later than that of Baeyer. See—R. 14 and 48.



-  Vaubel, W.—1892. *J. prakt. Chem.* **46**, 51. Formation of phenylene oxide.
309. — Voit, E. See Bischoff, C. A.
310.  Wachter, V.—1890. (*Chem. Centrbl.* [4] **2**, I, 457, 505, 561, 617, 849. Benzene. A Review. —R. 14.)
311. — Waechter, F.—1878. *Chem. Centrbl.* [3] **9**, 648, 667. Relative volumes of the atoms.
312. C Wagner, G.—1886 and '89. *Gazz. chim. ital.* **16**, 390; *Ber.* **22**, 3057. Piperylene bromides.
313.  Wagner, J.—1888.—*Chem. Centrbl.* [3] **19**, II, 1333. On the benzene configuration of Sachse.
314. || Walden, P.—1890. *Ber.* **23**, 1958. Stilbene group. 1891. (*Ztschr. phys. Chem.* **8**, 433.—R. 30.)
- | “ See Bischoff, C. A.
315. | Walker, James.—1892. *J. Chem. Soc.* **61**, 696, 1088. Dissociation constants of organic acids.
316. — Walker, J. Wallace. See Purdie, T.
317. C Wallach, M.—1884. *Ann.* **226**, 80. A possible third hydrobenzoïn. 1884-'92. *Ann.* **225**, 314; **227**, 277; **230**, 225; **238**, 78; **239**, 1; **241**, 315; **245**, 191, 241; **246**, 221; **252**, 94, 106, 136; **258**, 319; **259**, 309; **263**, 129; **264**, 1; **268**, 197; **269**, 326; **270**, 171. Terpenes. 1891. *Ber.* **24**, 1525. Terpenes; review.
- C “ and Brass, W.—1884. *Ann.* **225**, 291. Terpenes.
- C “ and Conrady, C.—1889. *Ann.* **252**, 141. Terpenes.
- C “ and Gildermeister, E.—1888. *Ann.* **246**, 265. Terpenes.
- C “ and Otto, A.—1889. *Ann.* **253**, 149. Terpenes.
318. — Warder, R. B.—1890. *Am. Ass. Adv. Sci.* **39**, 111. Stereochemistry. Review with bibliography.

319. — Warrington, A. See Meyer, V.
320. C Weger, F.—1883. Ann **221**, 68. Styrolene is a mixture. Compare Berthelot, D.
321. N Wegerhoff, P.—1889. Ann. **252**, 11. Methylbenzophenone oxime. Communicated by Beckmann.
322.  Wendt, G.—1890. Deutsche Chem. Ztg. **5**, 194. (Ref. Chem. Centrbl. [4] **2**, II, 196.) Benzene and naphthalene.
323. — Wenzel, C. F.—1777. “Lehre von der Verwandtschaft der Körper.” Dresden, G. A. Gerlach, 16mo, pp. iii+492. Affinity is explained by the forms of the smallest particles. See especially pp. 8, *et seq.*
324. N Werner, A.—1890. “Ueber räumliche Anordnung der Atome in Stickstoffhaltigen Molekülen.” —Ber. **23**, 2331, 2333, 2336. Oximes.  
1891. Züricher Vierteljahrsschrift **36** (Ref. Ztschr. phys. Chem. **9**, 220). “Beiträge zur Theorie der Affinität und Valenz.”  
1892. (Ber. **25**, 27.—R. 45.) Hydroxamic acid derivatives.  
“ See Hantzsch, A.
325. — West, —.—1873. Bull. Soc. Chim. (Paris), [2] **19**, 544. On “L’architecture du monde des atomes” of Gaudin.
326. C Wheeler, H. J. and Tollens, B.—1889. Ann. **254**, 314. Xylose isomeric with arabinose.
327. — Wiegand, E.—See Beilstein, F.
328. C Will, W.—1885. Ber. **18**, 1311. Sorbite, isodulcite, etc.; especially p. 1321.  
1887. Ber. **20**, 1189. Sugars.  
1888. Ber. **21**, 1717. Atropine and hyoscyamine.  
1891. Ber. **24**, 400. Oxypyroracemic acid.  $\text{CO}_2\text{H}.\text{CO}.\text{CH}_2\text{OH}$ .  
C “ and Bredig, G.—1888. Ber. **21**, 2777. Hyoscyamine and atropine.

329. N Willgerodt, C.—1888 and 1890. (J. prakt. Chem. [2] **37**, 449 ; **41**, 291, 526 ; **42**, 63.—R. 39.)  
 1892. Verein deutscher Naturforsch ; **63**, II, 66. Elements of the nitrogen group.—J. prakt. Chem. [2] **45**, 554. Dinitrosoazobenzene; in answer to Kehrman and Messinger.—Ibid. **46**, 128. Nitrosoazo compounds.
- N “ and Herman, B.—1890. J. prakt. Chem. [2] **42**, 127.
330. N Williams, K. J., and Ramsay, W.—1886. Proc. Chem. Soc., p. 223. Supposed existence of an allotropic modification of nitrogen ; compare Johnson, G. S.
331. — Wing, J. F. See Michael, A.
332. II Wislicenus, J.—1873. (Ann. **167**, 302.—R. 2). Lactic acids ; (especially pp. 343–345).  
 1887. Abh. kgl. Sächs. Ges. der Wissensch. **14**, 1. “ Ueber die räumliche Anordnung der Atome in organischen Molekülen und ihre Bestimmung in geometrisch-isomeren ungesättigten Verbindungen.” Leipzig. Hirzel.  
 1887. Verein deutsch. Naturforscher, Tageblatt 240. Addition of bromine to acetylenedicarboxylic acid. (Compare Bandrowski, also Michael, A.)—Ber. **20**, 1008. Derivatives of crotonic acids. Two monochlorpropylenes.  
 1888. (Ber. **21**, 581.—R. 11.) Answer to Lossen’s paper in Ber. **20**, p. 3306.—Ann. **246**, 53. Fumaric and maleic acids.—Ann. **248**, 281. Crotonic acid and derivatives. Reply to Michael, A.  
 1889. Second, unaltered, edition of “ Räumliche Anordnung ; ” with notes, pp. 79, 8vo.—Verein Deutsch. Natur-

- Wislicenus, J.—forsch. 19 Sept. Atomic arrangement.—  
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pseudo-butylene, angelic and tiglic acids.  
1890. Ueber die Umwandlung stereoisomerer ungesättigter Verbindungen ineinander bei höherer Temperatur. Leipzig, pp. 32, 4°.
- “ See Blank, A.  
— “ See Eiloart, A.  
— “ See Hoff, J. H. van’t.  
— “ See Hölz, O.  
— “ See Just, F.  
— “ See König, Arn.  
— “ See Tillmanns, H.
333. — Wunderlich, Ae.—1886. (“ Configuration organischer Moleküle.” Würzburg.—R. 11), (Ref. Ber. 19, 592.)
334. C Wolff, L.—1885. Ann. 229, 249. Two lactones of levulic acid.
335. L Wurtz, Ad.—1857. Ann. chim. phys. [3] 51, 358. Caproic acid.
336. — Wurtz, Henry.—1876. Am. Chemist 6, 321, 440. Geometrical chemistry. Volumes of Molecules.
337. C Wyrouboff, G.—1884–’86. Bull. Soc. chim. (Paris), [2] 41, 210; 45, 52; Comptes rend. 102, 62. Crystallisation of racemates and tartrates.  
1886. Ann. chim. phys. [6] 8, 340. Reusch’s active piles.—Ibid. 9, 221. “ Doubling ” racemates.
338. | Zelinsky, N.—1888. Zhurnal Khim. 20, 672. (Ref. Chem. Centrbl. [4] 1, I, 782.) Dimethylsuccinic acids.  
1889. Ber. 22, 2823. Dimethylglutaric acids.  
1891. Ber. 24, 3997. Dimethyladipic acids.  
Ber. 24, 4006. Dimethyloxyglutaric acids.

- | Zelinsky, N., and Besredka, A.—1891. Ber. **24**, 459.  
Stereomeric trimethylsuccinic acids.  
(Compare Bischoff.)
- | “ and Buchstab, L.—1891. Ber. **24**, 1876.  
Phenylmethylsuccinic acids.
- | “ and Krapivin, S.—1889. Ber. **22**, 646.  
Dimethylsuccinic acids.
339. | Zincke, Th.—1877 and '79. Ber. **10**, 999; Ann. **198**,  
128. Hydrobenzoïns.  
1884. Ber. **17**, 708. Phenylmethylglycols.
- N<sup>v</sup> 1890. Ber. **23**, 1315. Azo derivatives of  
phenyl- $\beta$ -naphthylamine; especially p.  
1321.
340. — Zuurdeeg, J. See Klinger, H.

## CHRONOLOGICAL CLASSIFICATION OF PUBLICATIONS.

The numbers refer to the preceding list. Those occurring in more than one period are printed in heavy type.

First Period. Before the year 1800.

292, 323.

Second Period. 1800 to 1873 inclusive.

**12**, 26, 29, **33**, 47, 48, **51**, 58, 63, 89, 94, 95, **122**, 135, **140**,  
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Third Period. 1874 to 1884\* inclusive.

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270, **271**, 275, 280, **298**, **305**, 311, **317**, 320, 325, 336, **337**, **339**.

\*Von Baeyer began to develop Van't Hoff's theory in 1885, Wislicenus' in 1886.

Fourth Period. 1885\* to 1892 inclusive.

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## LIST OF REVIEWS.

### STEREOCHEMISTRY.

Auwers, K., 1890. "Entwicklung der Stereochemie," pp. 157.

Hoff, J. H. van't. "Dix Années" and its translations; see index. Especially valuable is the latest edition (Van't Hoff—Meyerhoffer, 1892) which is furnished with author- and subject-index.

Meyer, Victor, 1890. Ber. **23**, 567—619. "Ergebnisse und Ziele Stereochemischen Forschung."

Warder, W. B., 1890. Am. Ass. Adv. Sci., **39**, 111—129; with der Bibliography, 130—136.

### BENZENE AND DERIVATIVES.

Noyes, W. A., 1889. Am. Chem. J., **11**, 487—496.

Wachter, V., 1890. Chem. Centrbl. [4] **2**, I, 457, 505, 561, 617, 849.

Wallach, M., 1891. Ber. **24**, 1525, 1579. Terpenes.

### HYDROXYLAMINE AND DERIVATIVES.

Keiser, E. H., 1889. Am. Chem. J., **11**, 480—487.

## SUGARS.

Fischer, E., 1890. Ber. 23, 2114. Syntheses; with Bibliography.

Keiser, E. H., 1889-'90. Am. Chem. J., 11, 277, 12, 357, pp. 19.

Stone, W. E., 1892. Am. Chem. J., 14, 399-405. Configuration of grape-sugar and its isomers.

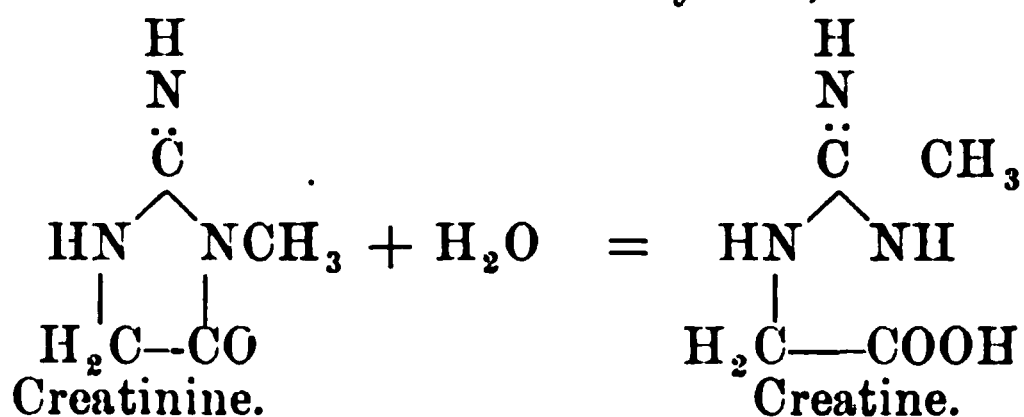
## TAUTOMERISM.

The literature of this subject has no place in the index, as its bearing on stereochemistry is too indirect, and it seems sufficient to refer here to the review by

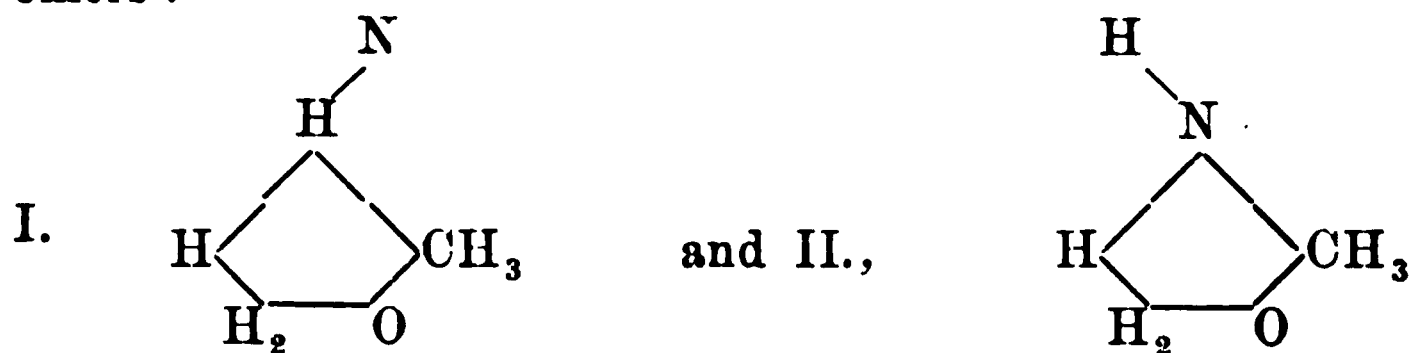
Orndorff, W. R., 1892. Am. Chem. J., 14, 238-246.

## NOTE ON THE STEREOCHEMISTRY OF CREATININES.

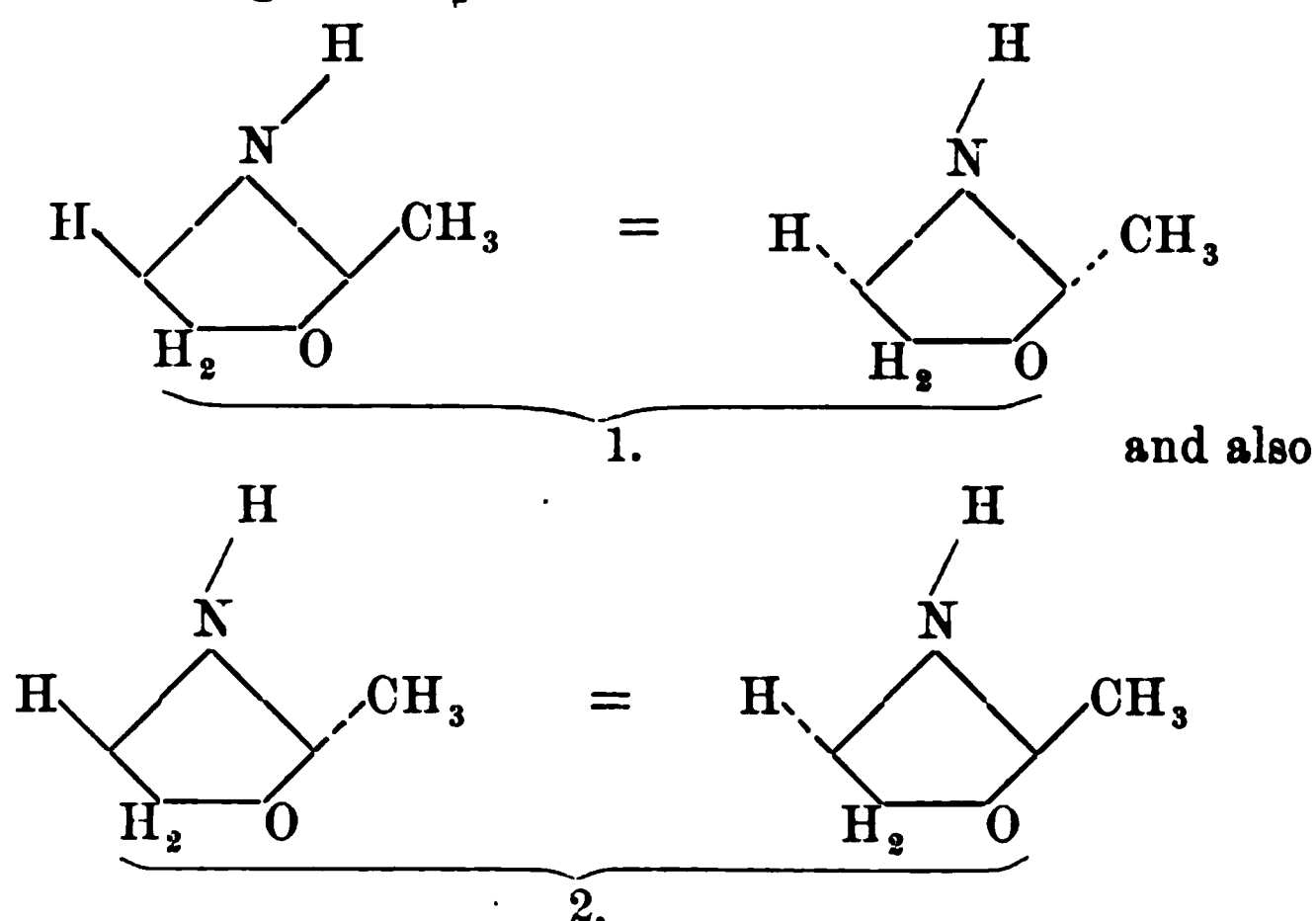
These compounds seem to represent a new class of isomers. According to Johnson there are, including Liebig's base, four distinct substances having the composition of creatinine (besides three which differ in composition from these in that each contains two molecules of water). The fact that no more than one creatine has yet been obtained from the four creatinines shows they are probably identical in structure. In every case, so far as is known,



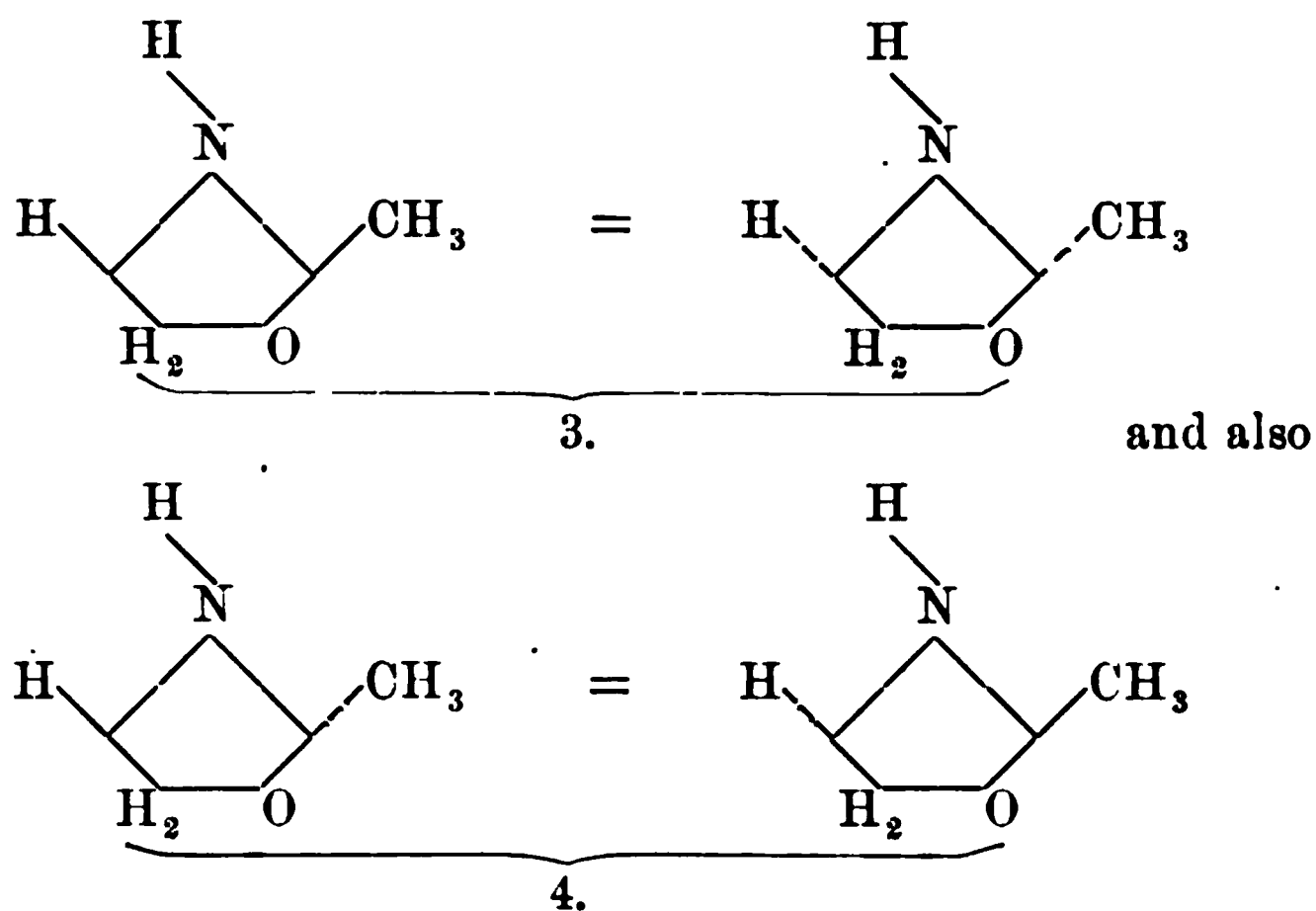
Now corresponding to this structural formula for creatinine there are, according to the Hantzsch-Werner theory, two stereoisomers :



but if the nitrogen valences maintain in this compound what is supposed to be their normal inclination of  $120^\circ$  (compare Bischoff, Ber. 23, 1974), then the methyl-group and the corresponding hydrogen-atom are not in the plane of the ring, and each of the above formulae represents two compounds in one, of which H and  $\text{CH}_3$  are on the same side, in the other on opposite sides of the plane of the ring. I. represents :



II. represents :





Theoretically, then, as practically, four creatinines are found to exist; and if this theory proves correct we must add to the nitrogen stereomers foreseen by Hantzsch and Werner another class consisting of the nitrogen analogues of the cis-trans isomers of Van't Hoff and von Baeyer. Of this class the creatinines would be the first known representatives.

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## Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

Issued July 5, 1892.

**478,093.**—Filter. Samuel G. Derham, Cincinnati, Ohio.

**478,097.**—Electric measuring instrument. Sydney Evershed, London, Eng.

**478,098.**—Apparatus for the measurement of electrical resistances. Sydney Evershed, London, Eng.

**478,099.**—Milk tester. Frank B. Fargo, Lake Mills, Wis.

**478,106.**—Therapeutical coating. Ludwig O. Helmers, Hamburg, Germany.

A coating consisting of starch, water, ichthyol and carbolic acid.

**478,110.**—Process of reducing zinc or spelter from ores. Christopher James, Swansea, Eng.

A process for the treatment of zinc sulphide ores by "first calcining a part of the ore in a calcining furnace to the form of an oxide, then mixing the calcined ore with rather more than half its weight of crude ore and smelting the same in the hearth of a neutral or slightly reducing reverberatory furnace until reduced to zinc and  $\text{SO}_2$ , the zinc being volatilized and collected by condensation in a chamber distinct from the furnace."

**478,132.**—Ammonia distilling apparatus. William L. Rowland, Philadelphia, Pa.

**478,134.**—Drier for teas and fruits. Benjamin L. Ryder, Chambersburg, Pa.

**478,157.**—Water filter. Olaf Eastman, San Francisco, Cal.

**478,159.**—Separating apparatus. Eugene L. Howe, Cleveland, Ohio.

**478,176.**—Method and apparatus for carbonating beer. John B. Strobaeus and Frederick C. Wackenfuth, Newark, N. J.

**478,179.**—Strainer for chemical wood pulp. Christian Wandel, Rentlingen, Germany.

**478,188.**—Process of brewing beer. Charles H. Frings and Bertha O. Frings, New York, N. Y.

The hops are subjected to heat until at least parched, and the hops then treated with water at a temperature above  $50^{\circ}$  F., and the infusion added to the wort.

**478,189.**—Method of hopping malt liquors. Charles H. Frings and Bertha O. Frings, New York, N. Y.

The hops treated as above are added to the wort.

**478,198.**—Carbonic acid gas generator. Patrick J. Maguire, Salem, Mass.

**478,203.**—Heating apparatus. James F. McElroy, Albany, N. Y.

**478,209.**—Ore pulverizer. John J. Stuart, New York, N. Y.

**478,211.**—Oven for oil, gas or gasoline stoves. Henry F. Bartlett, Springfield, Mo.

**478,229.**—Adhesive. Jerome W. Frank, New York, N. Y.

An adhesive consisting of the liquor of bisulphite fiber or wood pulp and an alkali.

**478,230.**—Secondary battery. James H. Gerry, Brooklyn, and Charles S. Long, New York, N. Y.

**478,238.**—Solder for aluminium. Joseph W. Richards, Philadelphia, Pa.  
An alloy of aluminium, zinc and phosphor tin.

**478,251.**—Oil filter. James B. Crane, Newnan, Ga.

**478,252.**—Grinding mill. George R. Cullingworth, Mount Vernon, N. Y.

**478,253.**—Pulverizing machine. Uriah Cummings, New Haven, Conn.

**478,261.**—Filter. Omar H. Jewell, William M. Jewell and Ira H. Jewell, Chicago, Ill.

**478,265.**—Distilling apparatus. Heinrich Propfe, Mannheim, Germany.

**478,268.**—Process of making lampblack. Swan P. Wenstran and Erastus R. Blood, Ludlow, Pa.

**478,276.**—Rheostat. Winslow P. Eayrs, Nashua, N. H.

**478,282.**—Apparatus for coating metal sheets. Richard Heathfield, Darlaston, Eng.

**478,290.**—Suction apparatus for paper mills. Ephraim Sanderson and Frank C. Base, Cleveland, Ohio.

**478,295.**—Liquid fuel burner. Edwin Squire, Montclair, N. J.; George H. Cobb, Elmira; and Forrest M. Towl, Brooklyn, N. Y.

**478,305.**—Apparatus for the manufacture of water-gas. Joseph Askins, Lima, Ohio.

**478,328.**—Glass-heating oven. Andrew O. Hurley, Jeannette, Pa.

**478,364.**—Bunsen burner. Georg Reimann, Berlin, Germany.

**478,365.**—Filter can. Franz Rerrich, Buda-Pesth, Austria-Hungary.

**478,366.**—Explosive compound. Samuel Rodgers, San Francisco, Cal.  
A compound of picrate of ammonia, nitrate of ammonia and nitro-glycerin.

**478,373.**—Apparatus for automatically regulating temperature. Alexander Shiels, Glasgow, Scotland.

**478,401.**—Smoke-consuming furnace. Edward Cartwright, Wilber, Neb.

**478,407.**—Ammonia still. Nathan W. Condict, Jr., Jersey City, N. J.

- 478,418.—Process of fermenting. Jean Effront, Brussels, Belgium.  
 478,419.—Wool-washing machine. Walter T. Forbes, Atlanta, Ga.  
 478,425.—Process of generating gas. William H. Harris, Boston, Mass.  
 478,458.—Water still. Johannes Peterson and Louis H. Liebeck, New York, N. Y.  
 478,459.—Method of manufacturing gas. Henry M. Pierson, Brooklyn, N. Y.  
 478,488.—White lead corroding pit. William H. Wetherill, Philadelphia, Pa.  
 478,495.—Antiseptic Quinoline. Joseph Ziegler, Biebrich, Germany.  
 478,499.—Apparatus for scouring and washing skins, etc. Thomas Burns, Edinburgh, Scotland.  
 478,502.—Fluid support for ore concentrating belts. Frederick G. Corning, New York, N. Y.  
 478,508.—Process of obtaining extracts from hops. Charles H. and Bertha O. Frings, New York, N. Y.  
 478,526.—Water supply regulator. Frederick G. Schuerman, Twin Bluffs, Wis.  
 478,539.—Sewage separating and purifying apparatus. William F. Goodhue, Milwaukee, Wis.  
 478,543.—Manufacture of compounds of pyroxyline. John H. Stevens, Newark, N. J.  
 A solution of pyroxyline in a menstruum of benzine, wood-alcohol and acetate of methyl.

*Issued July 12, 1892.*

- 478,549.—Fuel gas apparatus. John M. Bailey, Bristol, Va.  
 478,551.—Magnetic separator. Clinton M. Ball, Troy, N. Y.  
 478,553.—Compound for filling cob pipes. Albert C. Bausches, Lanark, Ill.  
 478,571.—Apparatus for the manufacture of gas. André Coze, Rheims, and Alexandre Lencanhez, Paris, France.  
 478,587.—Mixing or separating machine. Henry M. Gabel, Avondale, Ohio.  
 478,588.—Ore crusher. Edward R. Gale, Chicago, Ill.  
 478,630.—Black ash dissolver. George M. Newhall and Charles L. Hamilton, Philadelphia, Pa.  
 478,652.—Apparatus for impregnating liquors in bottles. Emil Stern, Vienna, Austria-Hungary.  
 478,661.—Electrode for storage batteries. Henri Tudor, Rosport, Luxemburg.  
 478,664.—Electrode. Armond Vanden Kerckhove, Brussels, Belgium.  
 478,667.—Mashing apparatus. Adam C. Wagner, Philadelphia, Pa.  
 478,693.—Process for total combustion. Emil A. Erb, Appleton, Wis.

**478,697.**—Disinfecting apparatus. Charles B. Hyslip, Bradford, Pa.

**478,701.**—Thermal alarm. Hosea F. Maxim and Jesse M. Price, Norfolk, Va.

**478,733.**—Lamp for burning hydrocarbons. Gustav Barthel, Dresden, Germany.

**478,736.**—Manufacture of butter. Walter Cole, London, Eng.

**478,737.**—Apparatus for testing milk. Modestus J. Cushman, Waterloo, Iowa.

**478,780.**—Fire proof paint. William Church, St. Paul, Minn.

• Consists of linseed oil, lime water, borax, glue sizing, a mineral paint and a suitable drier.

**478,788.**—Electrical thermostat. William L. Denio, Rochester, N. Y.

**478,819.**—Explosive compound. Addison C. Rand, New York, N. Y.

**478,844.**—Nitro-glycerin blasting powder. Lewis Brown, Landing, N. J.

**478,865.**—Electric time alarm. John Jacobi, Brooklyn, N. Y.

**478,870.**—Detergent paste. Joseph Judge, Pittston, Pa.

**478,871.**—Dental vulcanizer. John Johnson, St. Louis, Mo.

**478,892.**—Transfer paper and composition for coating the same.

The absorbent coating is composed of glycerin, carpenters' glue, Russian glue, agar agar and sirup.

**478,906.**—Feed pipe for vacuum pans. Henry Basanta, Ponce, Porto Rico.

**478,907.**—Process of reducing metals. Henry S. Blackmore, Mount Vernon, N. Y.

**478,908.**—Furnace for reducing metals. Henry S. Blackmore, Mount Vernon, N. Y.

**478,922.**—Amalgamator. William J. Connors and William W. Eddy, Grass Valley, Cal.

• **478,951.**—Plaster. Charles Casteel, St. Louis, Mo.

A composition consisting of water-lime, gypsum, coke and brick dust.

**478,955.**—Compound of sulphureted oils. Walter D. Field, Milburn, N. J.

A compound of glyceryl or glyceryl ethers, combined with sulphuric acid to form sulpho-fatty acid compounds and pyroxyline or nitro-cellulose.

**478,971.**—Machine for extracting gold from pulverized ores. Thomas C. Simonton, Paterson, N. J.

*Issued July 19, 1892.*

**478,980.**—Apparatus for recovering alkali. Henry Blackman, New York, N. Y.

**478,981.**—Apparatus for and process of recovering alkali. Henry Blackman, New York, N. Y.

**479,018.**—Ore and coal crusher and separator. Samuel B. Price, Jr., Charles E. Martin, and Benjamin Purser, Brookwood, Ala.

**479,019.**—Process of hardening objects made of crude gypsum. Carl Reimer, Halle, Germany.

The objects are dried by the application of heat and then steeped in a solution of hydrate of barium and afterward in a solution of oxalic acid.

**479,021.**—Enameled brick, and process of making the same. Isaac T. Rue, Matawan, N. J.

**479,060.**—Composition of matter for plastering. Edward W. Dickie, Clyde, N. Y.

**479,100.**—Smoke consuming furnace. Robert L. Walker, Boston, Mass.

**479,101.**—Rheostat. John Waring, Manchester, Conn.

**479,115.**—Annealing furnace. Alfred A. Cowles, New York, N. Y., and Joseph F. Gilpin, Ansonia, Conn.

**479,130.**—Process of separating yeast cells. Rudolf Allert, New York, N. Y.

**479,140.**—Amalgamator and ore concentrator. Lavoisier C. Moreland, Ogilby, Cal.

**479,188.**—Means for preventing explosions in mills. Charles Kaestner, Chicago, Ill.

**479,189.**—Brewer's mashing machine. Charles Kaestner, Chicago, Ill.

**479,190.**—Beer apparatus. Frank M. Boiteaux, Cincinnati, Ohio.

**479,193.**—Process of testing milk. Henry Leffmann and William Beam, Philadelphia, Pa.

Process for separating the fat from milk by adding a mixture of alcohol and hydrochloric acid to the milk, then heating the mixture by adding sulphuric acid, and finally imparting to the containing vessel centrifugal motion.

**479,238.**—Air supplying device for gas machine. Edgar B. Badlaw, San Francisco, Cal.

**479,243.**—Apparatus for manufacturing paper pulp. John B. Carter, Kokomo, Ind.

**479,250.**—Apparatus for clarifying sugar solutions. Eugene W. Deming, New Orleans, La.

**479,260.**—Air compressor. Thomas F. Farrell, Paterson, N. J.

**479,263.**—Art and apparatus for making parchmented fiber tubes. Robert P. Frist, Wilmington, Del.

**479,264.**—Art and apparatus for making parchmented fiber tubes. Robert P. Frist and Charles G. Rupert, Wilmington, Del.

**479,267.**—Apparatus for separating dust from air. Pieter Van Gelder, Sowerby Bridge, England.

**479,271.**—Steam condenser. Charles Grohman, Linoleumville, N. Y.

**479,277.**—Fluid meter. Frederic W. Holt, St. George, Canada.

**479,279.**—Ore concentrator. Gottlieb D. Husemann, St. Louis, Mo.

**479,290.**—Process of treating nickel matte. Pierre Manhes, Lyons, France.

**479,293.**—Process of manufacturing gas. Frank D. Moses, Chicago, Ill.

**479,298.**—Bottle filling apparatus. Michael J. McHugh, Jersey City, N. J.

**479,305.**—Manufacture of photographic films. Henry M. Reichenbach, Rochester, N. Y.

**479,365.**—Process of plating clay with glass and in articles made accordingly. Arthur A. Houghton and Robert D. Haines, Corning, N. Y.

**479,367.** { Means for utilizing heat of lamps. Alexander S. H. and Anna  
**479,368.** { Johnston, Columbiana, Ohio, and James G. Thompson, New  
 Brighton, Pa.

**479,378.**—Combined pump and mixer. Albert M. Phillips, Lockport, N. Y.

**479,381.**—Liquid purifying device. Frank K. Way, Dayton, Ohio.

**479,388.**—Apparatus for blacking and dyeing. George Young, Winton, and Frank Pearn, Gorton, England.

*Issued July 26, 1892.*

**479,402.**—Food product and method of making the same. Samuel Crump, Montclair, N. J.

A non-fibrous food compound, composed of the natural ingredients of the cocoanut deprived of the fibrous portions of the nut, having added thereto sugar and the milk of the cocoanut and reduced to a condensed or dessicated form by evaporation *in vacuo*.

**479,403.**—Filter. John J. Curran, Toledo, Ohio.

**479,405.**—Garbage or refuse crematory. Alfred G. Delanoy, New York, N. Y.

**479,408.**—Reduction of iron ore. Charles J. Eames, New York, N. Y.

The iron is intimately mixed with a bituminous reducing agent termed "brea" and the mixture reduced in a suitable furnace.

**479,419.**—Apparatus for cooling malt liquors. Clarence C. Hanford, Medford, and Charles D. Stanford, Boston, Mass.

**479,421.**—Apparatus for manufacturing malt. Charles Hauptmann and Joseph Schwarz, Chicago, Ill.

**479,437.**—Charging machine for furnaces. Johan F. Lundahl, Homestead, Pa.

**479,439.**—Fluid pressure valve. Harry G. Manning, Watertown, N. Y.

**479,451.**—Machine for making cement pipes. Emanuel Oehrle, Omaha, Neb.

**479,453.**—Process of separating particles of different degrees of specific gravity. Orrin B. Peck, Chicago, Ill.

**479,454.**—Generation of steam power. Cassius C. Peck, Warsaw, N. Y.

**479,455.**—Process of separating powdered or finely divided particles, etc. Orrin B. Peck, Chicago, Ill.

**479,456.**—Centrifugal ore separator. Orrin B. Peck, Chicago, Ill.

**479,462.**—Pressure regulating valve. Carl A. Rempen and Emil Andre, Hanover, Ger.

**479,489.**—Process of enriching lead fumes. Arthur Chanute and Malvern W. Iles, Denver, Col.

The metallic fumes are screened and saved as well as the solid particles from lead reducing furnaces. Sulphide of silver is spread between layers of the fumes and the latter ignited and the resultant solid mixture further treated in furnaces.

**479,494.**—Milk cooler. William C. Eberhardt, Plymouth, Wis.

**479,496.**—Apparatus for reducing bituminous rock. Archibald Ford, Golden Gate, Cal.

**479,515.**—Olive dye. Richard Lauch, Elberfeld, Germany.

**479,553.**—Gas governor. Samuel G. Cabell, Washington, D. C.

**479,557.**—Electroplating toy apparatus. Edward A. Clark, Boston, Mass.

**479,562.**—Machine for cleaning and peeling vegetables. Frederick Groos, Naples, N. Y.

**479,580.**—Soluble chocolate. Servetus T. Achor, Brooklyn, N. Y.

A cake composed of chocolate, cream and sugar and having incorporated such an additional amount of sugar as will render the cake readily disintegrable in water and provided with a protective coating.

**479,581.**—Process of making soluble chocolate. Servetus T. Achor, Brooklyn, N. Y.

The process consists in first making a paste of chocolate or cocoa, cream and sugar, then incorporating an additional amount of sugar, molding to form cakes, immersing such cakes in a thick sirup to obtain a crystalline coating.

**479,617.**—Separator for crushed cement, etc. Joseph R. Berthelet, Milwaukee, Wis.

**479,640.**—Compound for preserving the color of finishing-bricks. Jacob D. Graybill, Shreveport, La.

**479,647.**—Gas generator. John J. Kirkham, Terre Haute, Ind.

**479,673.**—Apparatus for producing variegated lights. Frank L. M. Smith and William J. Bryan, Chicago, Ill.

**479,689.**—Manufacture of rose or orange stained glass. Franz Wolz, Klostergrab, Austria-Hungary.

The molten glass is mixed with selenium and cadmium sulphide.

**479,690.**—Oil and vapor burner. William H. Wilder, Florence, Mass.

**479,707.**—Apparatus for producing mixtures of steam and hot air. Edward Field, London, England.

**479,710.**—Manufacture of disinfectants. Heinrich Heidenhain, Chicago, Ill.



Acetate of soda is melted and then one-third of its weight of beta naphthol is added to the molten mass and the mixture finally allowed to harden. A white powder readily soluble in water and alcohol.

**479,743.**—Process of mounting metallic ornaments upon glass, etc. Charles B. Headley and John S. Carron, Philadelphia, Pa.

**479,747.**—Oil and vapor burner. John A. Lannert and William R. Jearous, Cleveland, Ohio, and William H. Wilder, Florence, Mass.

**479,753.**—Secondary battery. Arthur E. Colgate, New York, N. Y.

**479,759.**—Proportional meter. William D. Hawley and Silas J. Hogan, Syracuse, N. Y.

**479,761.**—Temperature regulator. Washington H. Kilbourn, Greenfield, Mass.

**479,767.**—Smoke consuming apparatus for boiler and other furnaces. Wesley Smith, Toledo, Ohio.

**479,769.**—Hot air furnace. William Thuener, Jr., and Paul Herchenbach, St. Louis, Mo.

*Issued August 2, 1892.*

**479,778.**—Apparatus for cooling liquids. Peter Bender, Mannheim, Germany.

**479,781.**—Process of purifying liquids. Courtland W. Brunson, Hamilton, Ohio.

**479,785.**—Paint. Samuel P. Citizen, Terre Haute, Ind. A paint consisting of rosin oil, sulphate of copper, and Chattanooga red.

**479,786.**—Galvanic battery. Martin M. Clark, Chicago, Ill.

**479,807.**—Micrometer-calipers. Edwin L. Holcomb, Springfield, Mass.

**479,827.**—Apparatus for kneading dough and shaping it into loaves.

**479,835.**—Storage battery plate. Harry G. Osburn, Chicago, Ill.

**479,849.**—Thermostat. Thomas W. Shepherd, Peabody, Mass.

**479,852.** } Weighing machine. Ephriam W. Spear, Boston, Mass.  
**479,853.** }

**479,855.**—Fluid motor. Henry C. Stilwell, Dayton, Ohio.

**479,865.** } Apparatus for purifying sewage. John Wilson, New York,  
**479,866.** } N. Y.

**479,869.**—Gas water heater. Walter S. Wright, Chicago, Ill.

**479,877.**—Pump for refrigerating apparatus. Max Grimm, West Hoboken, N. J.

**479,882.**—Apparatus for removing iron and alumina. Samuel Hughes, Charleston, S. C.

**479,886.**—Electric current regulator. Alvan S. Krotz, Defiance, Ohio.

**479,887.**—Galvanic battery. Felix de Lalande, Paris, France.

**479,925.**—Double salts of fluoride of antimony and sulphate of ammonia. Carl Wachendorff, Oestrich, Germany.

**479,935.**—Solution of myrrh resin and mode of making the same. Adolf Flügge, Frankfort-on-the-Main, Germany.

A solution of myrrh resin in castor oil prepared by dissolving myrrh in alcohol and castor oil, filtering from any insoluble matter, and finally driving off the alcohol.

**479,941.**—Influence generator of electricity. William Henry, Detroit, Mich.

**479,953.**—Process of separating powdered or finally divided particles. Orrin B. Peck, Chicago, Ill.

**479,954.**—Centrifugal ore separator. Orrin B. Peck, Chicago, Ill.

**479,955.** Centrifugal ore separator. Orrin B. Peck, Chicago, Ill.

**479,967.**—Plastic composition. Raphael G. De Vassau, Paris, France.

A composition consisting of one or two volumes of fragments of powder of cork and two to one volumes of an agglutinant composed of plaster of paris, dextrine, sesquioxide of iron, and an oxychloride, such as the oxychloride of zinc.

**479,970.**—Method of preserving eggs. Eugene T. Burnette, Haywards, Cal.

The eggs are submitted to the fumes arising from the combustion of a mixture of chlorate of potash, sugar and salicylic acid.

**479,988.**—Method of restoring nitrating acids. Hudson Maxim, New York, N. Y.

Dry nitrate is added to the weakened mixture of nitric and sulphuric acids, and the sulphate allowed to crystallize and then removed by centrifugals.

**480,028.**—Apparatus for making bleaching powder. Edmund C. Nation, Peekskill, N. Y.

**480,033.**—Method of preparing battery solutions. Edward Poppowitsch, Brooklyn, N. Y.

A method for preparing saturated battery solutions such as "bichromate of potash or analagous depolarizing salt for use in a voltaic battery, consisting in suspending a mass of bichromate crystals in a volume of water at a point near the bottom of the containing vessel until the lower portion of the volume is completely saturated, then raising the mass a short distance until an additional portion of the volume is completely saturated, and continuing the successive steps until the entire or complete saturation is effected."

**480,038.**—Testing apparatus for electric lighting circuits. Charles H. Rudd, Evanston, Ill.

**480,039.**—Device for measuring electrical currents. Charles H. Rudd, Evanston, Ill.

**480,084.**—Machine for decorticating ramie, etc. Walter T. Forbes, Atlanta, Ga.

**480,089.**—Compressed air motor. Paul Gifford, Paris, France.

**480,094.**—Composition for and method of making heads and limbs of dolls. Solomon D. Hoffmann, Moscow, Russia.

The method for producing the heads and limbs of dolls “consist in reducing glue, glycerine, zinc oxide and Japanese wax to a liquid state, pouring the liquid into molds, smoothing the molded mask, dipping the mask in a bath of glue, glycerine, white zinc oxide, Japanese wax and coloring matter reduced to a thin liquid, and finally decorating the molded article and immersing it in its decorated state in a bath of collodion.”

**480,102.**—Process of bleaching. Samuel D. Keene, Providence, R. I.

A process for bleaching fibrous or porous materials by “first, placing the material or substance, in a dry condition, within a keir; second, exhausting the air from the keir to form a vacuum; third, admitting the bleaching chemic to the keir at atmospheric pressure; fourth, creating a considerably increased artificial pressure upon the stationary body of chemic within the keir; fifth, removing the chemic from the keir; sixth, repeating the second, third, fourth and fifth steps in connection with the same; seventh, repeating said second to fifth steps inclusive in connection with the washing liquid, and finally removing the material or substance from the keir and drying the same.”

**480,103.**—Combined radiating and hot water or air heating furnace. John H. Keyser, New York, N. Y.

**480,109.**—Process of recovering sulphur, carbonate of soda and iron oxide. George Lunge, Zurich, Switzerland, and James Dewar, Cambridge, England.

Intended for the residue obtained by decomposing sodium sulphide with a ferrite. Process consists in acting on the moist residue with a suitable mixture of carbonic acid and oxygen.

**480,134.**—Brick kiln. William Radford, San Francisco, Cal.

**480,151.**—Rheostat. Charles W. Tobey, New Bedford, Mass.

**480,161.**—Apparatus for the manufacture of gas. Joseph Askins, Lima, Ohio.

**480,193.**—Air compressor. John G. Haines, Omaha, Neb.

**480,211.**—Apparatus for the manufacture of gas. Lewis C. Parker, Indianapolis, Ind.

**480,232.**—Apparatus for melting and casting metals. Craft C. Carroll, New York, N. Y.

**480,233.**—Alloy. Alexander I. Cocker, George W. Collyer and Clarence Haines, Tarrytown, N. Y.

An alloy of iron and tin prepared by fusing the metal in presence of a flux composed of borax, carbonate of iron, sal-ammoniac and salt.

**480,234.**—Manufacture of asphaltum. Jesse A. Dubbs, Allegheny, Pa.

**480,235.**—Manufacture of asphaltum. Jesse A. Dubbs, Allegheny, Pa.

*Issued August 9, 1892.*

**480,248.**—Apparatus for manufacturing gas. Joseph H. Collins, Jr., Philadelphia, Pa., and Isaac N. Knapp, Greenwich, Conn.

**480,249.**—Gas producing apparatus. Joseph H. Collins, Jr., Philadelphia, Pa., and Isaac N. Knapp, Paterson, N. J.; Rebecca S. Collins and William J. Collins.

**480,253.**—Drying kiln. Charles J. Dion, St. Paul, Minn.

**480,266.**—Secondary battery plates. Edward R. Knowles, Brooklyn, N. Y.

An alloy of about 82 parts lead, 16 parts tin, 1.9 parts antimony and 0.1 part arsenic.

**480,283.**—Wool washing machine. Frederick G. Sargent and Allan C. Sargent, Graniteville, Mass.

**480,286.**—Generator for the vaporization of liquids. Leon Serpollet, Paris, France.

**480,301.**—Ore concentrator. Charles B. Walker, Trinidad, Col.

**480,311.** } Process of desulphurizing oils. Otto P. Amend and Josiah

**480,312.** } H. Macy, Harrison, N. Y.

The oil is vaporized and the vapor exposed to a degree of heat, at or above the boiling point of sulphur, and then subjected to the action of oxidizing agents and alkalies.

**480,326.**—Diazo dye. Meinhard Hoffmann, Frankfort-on-the-Main, Germany.

One molecule of the amidonaphthodisulpho-acid H is introduced into the solution of one molecule of a diazo body in presence of a mineral acid; the solution is made alkaline and a second molecule of a diazo body is added; the separation of the dyestuff is completed by means of common salt.

The coloring matter is a greenish black powder easily soluble in water with a blue color. Difficultly soluble in spirit. Soluble in conc. sulphuric acid with a dark green shade, which on addition of water is changed to blue and a dark blue precipitate.

The dry stuff is composed of two molecules of diazo bodies, such as diazonitrobenzole, diazobenzole, and one molecule of amidonaphthodisulpho acid H.

**480,334.**—Process of preparing cellulose from wood. Hermann A. A. Maste, Arnsberg, Germany.

The process consists "in first softening the ligneous material by steam heat, then reducing the pressure in the vessel below that of the atmosphere to free the material from steam and air, then forcing a sulphite solution into the material under repeated variations of pressure, and finally decomposing the intercellular substances by steam heat."

**480,366.**—Amalgamating apparatus for crushed ores and like reduced bodies. William W. Fyfe, London, England.

**480,376.**—Process of making tanning extracts. Walton C. Tiffany, New York, N. Y.

Canaigre root is macerated in water at 140° F. and the infusion evaporated in vacuum.

**480,381.**—Combined cement mill and furnace. Henry H. Bourne, Trinidad, Col.

**480,384.**—Galvanic battery. Herbert H. Dow, Midland, Mich.

**480,405.**—Process of treating ores containing hydrated sesquioxide of iron. Clemens Jones, Easton, Pa.

**480,416.**—Art of desilverizing argentiferous lead. Heinrich Roessler, Frankfort-on-the-Main, Germany.

The lead is fused with an alloy of zinc and aluminium in the proportions of not more than one-half of one per cent. of aluminium to the zinc.

**480,445.**—Aluminium alloy. Christopher F. Whitney, Newton, Mass.

An alloy of aluminium 80 per cent. or more; a malleable metal, such as copper, 12 per cent. or less, and a metal of high fusing point, such as nickel, eight per cent. or less.

**480,491.**—Electrolytic cell. Elisha B. Cutten, New York, N. Y.

**480,492.**—Method of electrolytically producing potassium chlorate. Elisha B. Cutten, New York, N. Y.

Magnesium chloride is electrolyzed in the presence of potassium chloride and slaked lime. A solution of magnesium chloride is placed in contact "with the cathode and potassium chloride, magnesium chloride, and slaked lime in contact with the anode, the said magnesium chloride being separated from said potassium chloride, magnesium chloride and slaked lime by a porous partition, and then electrolyzing, whereby potassium chlorate is produced at the anode and magnesia at the cathode."

**480,493.**—Method of electrolytically producing potassium chlorate. Elisha B. Cutten, New York, N. Y.

**480,502.**—Dyeing or scouring machine. John H. Lorimer, Philadelphia, Pa.

**480,549.**—Phosphate separator and screen washer. George R. Boaz, Tampa, Fla.

**480,554.**—Bleaching compound. William B. Brittingham, New York, N. Y.

A compound consisting of the tungstate of an alkali combined with a hypochlorite.

**480,571.**—Diffusion apparatus. Samuel Faron, Pahala, Kau, Hawaii.

**480,575.**—Electric accumulator. Giovanni Gandini, Lodi, Italy.

**480,591.**—Composition of matter for the manufacture of artificial stone. Joseph E. Keseling and Charles Fuchs, Jr., New York, N. Y.

Consists of a basic cement of oxide of magnesium and neutral chloride of magnesium, asphaltum, and sand or analogous material.

**480,624.**—Fumigator. John T. Phelan, Cambridge, Mass.

**480,647.**—Quartz crusher. Andreas P. Anderson, Oriental, Nev.

**480,669.**—Perfumed starch and process of making the same. Frederick C. Norfolk, Des Moines, Iowa.

Paraffin is saturated with perfume and added to ordinary dry starch. Borax is also added.

480,686.—Process of refining fume. Frank L. Bartlett, Portland, Me.

480,687.—Gelatinous food product. Richard B. Beaumont, Rutherford, N. J.

480,699.—Smelting furnace. John S. Oliver, Brooklyn, N. Y.

*Issued August 16, 1892.*

481,702.—Apparatus for reclaiming soda ash. Lewis D. Armstrong, Lock Haven, Pa.; Meylert M. Armstrong, administrator of Lewis D. Armstrong.

480,761.—Stone and ore crushing machine. Edgar H. Booth, San Francisco, Cal.

480,770.—Paper making machine. Edward E. Johnson, Seneca Falls, N. Y.

480,812.—Diffusion apparatus. Edward F. Dyer and Harold P. Dyer, Cleveland, Ohio.

480,840.—Soap. Henry J. Echer and George F. Echer, Philadelphia, Pa. A soap composed of water, white soap, oxide of iron and pulverized quartz.

480,842.—Distilling apparatus. Alfred Feldmann, Bremen, Germany.

480,860.—Ore concentrator. Philip R. Stanhope, Dumont, Col., and Frank Wood, Brooklyn, N. Y.

480,883.—Storage battery. Edward P. Usher, Grafton, Mass.

480,884.—Battery cell. Edward P. Usher, Grafton, Mass.

480,885.—Storage battery. Edward P. Usher, Grafton, Mass.

480,886. } Battery plates. Edward P. Usher, Grafton, Mass.

480,887. }

480,891.—Temperature regulating device for electrical circuits. Edward Weston, Newark, N. J.

480,892.—Rheostat. Edward Weston, Newark, N. J.

480,893.—Rheostat. Edward Weston, Newark, N. J.

480,894.

480,895.

480,896.

480,897-98-99.

} Electrical measuring instrument. Edward Weston,  
Newark, N. J.

480,912.—Machine for re-pressing bricks. William W. Wallace and Raymond C. Penfield, Willoughby, Ohio.

480,919.—Apparatus for manufacturing gas. Walter P. Elliott, New York, N. Y.

480,920.—Process of recovering tin from tin plate. Manuel R. Garcia, London, England.

480,928.—Heater and cooler for fermented malt liquors. John H. Kersenbrock, Columbus, Neb.

480,934.—Acid-resisting composition for lining tanks. Joshua Norton, Jr., Chatham, Canada.

“ A lining of a digester composed of three superimposed layers or coats, the first consisting of hydraulic cement and other refractory material applied to the metal of the digester, the second containing hydraulic cement mingled with pulverized firebrick and other refractory material and imposed upon the first, and the third containing hydraulic cement and refractory materials upon the second.”

480,935. }  
480,936. } Brick kilns. James W. Penfield, Willoughby, Ohio.

480,940.—Brick kiln. William H. B. Stout, Chicago, Ill.

480,956.—Process of treating base brelliar amalgam. Bernard Moebius, New York, N. Y.

The amalgam is charged into an “ apparatus for distilling off and collecting the mercury, subjecting the heated charge to a comminuting action, while at the same time oxidizing the base metals by a current of air, and leaching the finely divided residue by sulphuric acid.”

481,004.—Apparatus for corroding lead. George D. Coleman, Chicago, Ill.

481,005.—Art of making lead protoxide. George D. Coleman, Chicago, Ill.

A quantity of comminuted lead in a state of agitation is subjected to the action of atmospheric air and water in a suitable vessel at a temperature of 75° to 150° Fahrenheit. The oxide is removed as fast as formed, and the lead replaced by a regulated supply of comminuted lead. The temperature is regulated by a proper inflow and outflow of water through the corroding vessel.

481,006.—Process of manufacturing white lead. George D. Coleman, Chicago, Ill.

“ The art of making white lead by the agitation of lead in a comminuted state in the presence of water, air and carbonic acid, the same consisting in carrying on the process at a regulated temperature of from 75° to 150° F. and under a pressure of from fifteen to thirty pounds, and preventing by a flow of water an abnormal rise in such temperature,” etc.

481,007.—Art of making white lead. George D. Coleman, Chicago, Ill.

481,023.—Transparent toy or puzzle picture and mode of producing the same. Wilhelm Grüne, Sr., Berlin, Germany.

481,031.—Art of amalgamating silver ore. Alexis Jouin, San Francisco, Cal.

481,061.—Fermenting process. Frederick W. Rueff, San Francisco, Ca.

481,075.—Electric battery. Peter Sterns, Charlottenburg, Germany.

481,085.—Heating and ventilating apparatus. Samuel W. Wayson, Detroit, Mich.

481,088.—Hydrocarbon burner. Ambrose Chaney and Edward T. Wires, Terre Haute, Ind.

481,101.—Ore concentrator. William H. H. Bowers, Denver, Col.

**481,108.**—Apparatus for the consumption of sewer gas. Jacob Eckhardt, St. Louis, Mo.

**481,109.**—Filtering or purifying feed water. James B. Edmiston, Liverpool, England.

**481,146.**—Refrigerating machine. Charles F. Miller, Lancaster, Pa.

**481,147.**—Apparatus for drying or cremating garbage and fecal matter. John H. Parke, Philadelphia, Pa.

*Issued August 23, 1892.*

**481,212.**—Drying apparatus. William D. Sunderlin, Green Island, N. Y.

**481,240.**—Hydrocarbon gas black machine. Lester J. McNutt, Warren, Pa.

**481,249.**—Aeration of liquids. Edward Williams, Aberayron, England.

**481,273.**—Hydrocarbon burner and device for automatically feeding the same. Charles F. A. Convert, Chicago, Ill.

**481,279.**—Composition of matter for the manufacture of artificial stone. Joseph E. Keseling and Charles Fuchs, Jr., New York, N. Y.

**481,282.**—Art of painting with distemper and other colors. Alfons Pereira, Stuttgart, Germany.

**481,287.**—Apparatus for recording and registering quantities of steam, etc. Franz Seiler, Mannheim, Germany.

**481,310.**—Gage for measuring the velocity of fluids. Stillman W. Robinson, Columbus, Ohio.

**481,313.**—Process of making malleable iron castings. Benjamin Talbot, Chattanooga, Tenn.

**481,391.**—Recovering waste products of petroleum. Jacob P. Engle, San Francisco, Cal.

**481,392.**—Separation of waste products of petroleum distillation. Jacob P. Engle, San Francisco, Cal.

**481,407.**—Production of caustic alkalies and chlorine. Farnham M. Lyte, London, England.

**481,407.**—A conjoint process of continuously producing alkali and chlorine, "which consists indecomposing an alkaline nitrate by heating it with ferric oxide to evolve nitrous fumes, decomposing the residue by boiling water into caustic alkali free from iron and a precipitate of ferric hydrate converting the nitrous fumes into aqueous nitric acid, dissolving plumbic oxide the rein, recipitating plumbic chloride, fusing it, and decomposing it electrolytically into chlorine and metallic lead, and finally converting this (or any other) lead into plumbic oxide and the ferric hydrate into ferric oxide for recommencing the cycle."

**481,414.**—Process of bleaching. Joseph A. Myrick, Salisbury, N. C.

The fiber is successively bleached in baths of chloride of lime and sulphurous acid.

**481,438.**—Coal or ore jigger and washer. Sebastian Stutz, Pittsburg, Pa.



Acetate of soda is melted and then one-third of its weight of beta naphthol is added to the molten mass and the mixture finally allowed to harden. A white powder readily soluble in water and alcohol.

**479,743.**—Process of mounting metallic ornaments upon glass, etc. Charles B. Headley and John S. Carron, Philadelphia, Pa.

**479,747.**—Oil and vapor burner. John A. Lannert and William R. Jearous, Cleveland, Ohio, and William H. Wilder, Florence, Mass.

**479,753.**—Secondary battery. Arthur E. Colgate, New York, N. Y.

**479,759.**—Proportional meter. William D. Hawley and Silas J. Hogan, Syracuse, N. Y.

**479,761.**—Temperature regulator. Washington H. Kilbourn, Greenfield, Mass.

**479,767.**—Smoke consuming apparatus for boiler and other furnaces. Wesley Smith, Toledo, Ohio.

**479,769.**—Hot air furnace. William Thuener, Jr., and Paul Herchenbach, St. Louis, Mo.

*Issued August 2, 1892.*

**479,778.**—Apparatus for cooling liquids. Peter Bender, Mannheim, Germany.

**479,781.**—Process of purifying liquids. Courtland W. Brunson, Hamilton, Ohio.

**479,785.**—Paint. Samuel P. Citizen, Terre Haute, Ind. A paint consisting of rosin oil, sulphate of copper, and Chattanooga red.

**479,786.**—Galvanic battery. Martin M. Clark, Chicago, Ill.

**479,807.**—Micrometer-calipers. Edwin L. Holcomb, Springfield, Mass.

**479,827.**—Apparatus for kneading dough and shaping it into loaves.

**479,835.**—Storage battery plate. Harry G. Osburn, Chicago, Ill.

**479,849.**—Thermostat. Thomas W. Shepherd, Peabody, Mass.

**479,852.** } Weighing machine. Ephriam W. Spear, Boston, Mass.  
**479,853.** }

**479,855.**—Fluid motor. Henry C. Stilwell, Dayton, Ohio.

**479,865.** } Apparatus for purifying sewage. John Wilson, New York,  
**479,866.** } N. Y.

**479,869.**—Gas water heater. Walter S. Wright, Chicago, Ill.

**479,877.**—Pump for refrigerating apparatus. Max Grimm, West Hoboken, N. J.

**479,882.**—Apparatus for removing iron and alumina. Samuel Hughes, Charleston, S. C.

**479,886.**—Electric current regulator. Alvan S. Krotz, Defiance, Ohio.

**479,887.**—Galvanic battery. Felix de Lalande, Paris, France.

**479,925.**—Double salts of fluoride of antimony and sulphate of ammonia. Carl Wachendorff, Oestrich, Germany.

**479,935.**—Solution of myrrh resin and mode of making the same. Adolf Flügge, Frankfort-on-the-Main, Germany.

A solution of myrrh resin in castor oil prepared by dissolving myrrh in alcohol and castor oil, filtering from any insoluble matter, and finally driving off the alcohol.

**479,941.**—Influence generator of electricity. William Henry, Detroit, Mich.

**479,953.**—Process of separating powdered or finally divided particles. Orrin B. Peck, Chicago, Ill.

**479,954.**—Centrifugal ore separator. Orrin B. Peck, Chicago, Ill.

**479,955.** Centrifugal ore separator. Orrin B. Peck, Chicago, Ill.

**479,967.**—Plastic composition. Raphael G. De Vassau, Paris, France.

A composition consisting of one or two volumes of fragments of powder of cork and two to one volumes of an agglutinant composed of plaster of paris, dextrine, sesquioxide of iron, and an oxychloride, such as the oxychloride of zinc.

**479,970.**—Method of preserving eggs. Eugene T. Burnette, Haywards, Cal.

The eggs are submitted to the fumes arising from the combustion of a mixture of chlorate of potash, sugar and salicylic acid.

**479,988.**—Method of restoring nitrating acids. Hudson Maxim, New York, N. Y.

Dry nitrate is added to the weakened mixture of nitric and sulphuric acids, and the sulphate allowed to crystallize and then removed by centrifugals.

**480,028.**—Apparatus for making bleaching powder. Edmund C. Nation, Peekskill, N. Y.

**480,033.**—Method of preparing battery solutions. Edward Poppowitsch, Brooklyn, N. Y.

A method for preparing saturated battery solutions such as "bichromate of potash or analagous depolarizing salt for use in a voltaic battery, consisting in suspending a mass of bichromate crystals in a volume of water at a point near the bottom of the containing vessel until the lower portion of the volume is completely saturated, then raising the mass a short distance until an additional portion of the volume is completely saturated, and continuing the successive steps until the entire or complete saturation is effected."

**480,038.**—Testing apparatus for electric lighting circuits. Charles H. Rudd, Evanston, Ill.

**480,039.**—Device for measuring electrical currents. Charles H. Rudd, Evanston, Ill.

**480,084.**—Machine for decorticating ramie, etc. Walter T. Forbes, Atlanta, Ga.

**480,089.**—Compressed air motor. Paul Gifford, Paris, France.

**480,094.**—Composition for and method of making heads and limbs of dolls. Solomon D. Hoffmann, Moscow, Russia.

The method for producing the heads and limbs of dolls “consist in reducing glue, glycerine, zinc oxide and Japanese wax to a liquid state, pouring the liquid into molds, smoothing the molded mask, dipping the mask in a bath of glue, glycerine, white zinc oxide, Japanese wax and coloring matter reduced to a thin liquid, and finally decorating the molded article and immersing it in its decorated state in a bath of collodion.”

**480,102.**—Process of bleaching. Samuel D. Keene, Providence, R. I.

A process for bleaching fibrous or porous materials by “first, placing the material or substance, in a dry condition, within a keir; second, exhausting the air from the keir to form a vacuum; third, admitting the bleaching chemic to the keir at atmospheric pressure; fourth, creating a considerably increased artificial pressure upon the stationary body of chemic within the keir; fifth, removing the chemic from the keir; sixth, repeating the second, third, fourth and fifth steps in connection with the same; seventh, repeating said second to fifth steps inclusive in connection with the washing liquid, and finally removing the material or substance from the keir and drying the same.”

**480,103.**—Combined radiating and hot water or air heating furnace. John H. Keyser, New York, N. Y.

**480,109.**—Process of recovering sulphur, carbonate of soda and iron oxide. George Lunge, Zurich, Switzerland, and James Dewar, Cambridge, England.

Intended for the residue obtained by decomposing sodium sulphide with a ferrite. Process consists in acting on the moist residue with a suitable mixture of carbonic acid and oxygen.

**480,134.**—Brick kiln. William Radford, San Francisco, Cal.

**480,151.**—Rheostat. Charles W. Tobey, New Bedford, Mass.

**480,161.**—Apparatus for the manufacture of gas. Joseph Askins, Lima, Ohio.

**480,193.**—Air compressor. John G. Haines, Omaha, Neb.

**480,211.**—Apparatus for the manufacture of gas. Lewis C. Parker, Indianapolis, Ind.

**480,232.**—Apparatus for melting and casting metals. Craft C. Carroll, New York, N. Y.

**480,233.**—Alloy. Alexander I. Cocker, George W. Collyer and Clarence Haines, Tarrytown, N. Y.

An alloy of iron and tin prepared by fusing the metal in presence of a flux composed of borax, carbonate of iron, sal-ammoniac and salt.

**480,234.**—Manufacture of asphaltum. Jesse A. Dubbs, Allegheny, Pa.

**480,235.**—Manufacture of asphaltum. Jesse A. Dubbs, Allegheny, Pa.

*Issued August 9, 1892.*

**480,248.**—Apparatus for manufacturing gas. Joseph H. Collins, Jr., Philadelphia, Pa., and Isaac N. Knapp, Greenwich, Conn.

**480,240.**—Gas producing apparatus. Joseph H. Collins, Jr., Philadelphia, Pa., and Isaac N. Knapp, Paterson, N. J.; Rebecca S. Collins and William J. Collins.

**480,253.**—Drying kiln. Charles J. Dion, St. Paul, Minn.

**480,266.**—Secondary battery plates. Edward R. Knowles, Brooklyn, N. Y.

An alloy of about 82 parts lead, 16 parts tin, 1.9 parts antimony and 0.1 part arsenic.

**480,283.**—Wool washing machine. Frederick G. Sargent and Allan C. Sargent, Graniteville, Mass.

**480,286.**—Generator for the vaporization of liquids. Leon Serpollet, Paris, France.

**480,301.**—Ore concentrator. Charles B. Walker, Trinidad, Col.

**480,311.** } Process of desulphurizing oils. Otto P. Ammend and Josiah

**480,312.** { H. Macy, Harrison, N. Y.

The oil is vaporized and the vapor exposed to a degree of heat, at or above the boiling point of sulphur, and then subjected to the action of oxidizing agents and alkalies.

**480,326.**—Diazo dye. Meinhard Hoffmann, Frankfort-on-the-Main, Germany.

One molecule of the amidonaphthodisulpho-acid H is introduced into the solution of one molecule of a diazo body in presence of a mineral acid; the solution is made alkaline and a second molecule of a diazo body is added; the separation of the dyestuff is completed by means of common salt.

The coloring matter is a greenish black powder easily soluble in water with a blue color. Difficultly soluble in spirit. Soluble in conc. sulphuric acid with a dark green shade, which on addition of water is changed to blue and a dark blue precipitate.

The dry stuff is composed of two molecules of diazo bodies, such as diazonitrobenzole, diazobenzole, and one molecule of amidonaphthodisulpho acid H.

**480,334.**—Process of preparing cellulose from wood. Hermann A. A. Maste, Arnsberg, Germany.

The process consists "in first softening the ligneous material by steam heat, then reducing the pressure in the vessel below that of the atmosphere to free the material from steam and air, then forcing a sulphite solution into the material under repeated variations of pressure, and finally decomposing the intercellular substances by steam heat."

**480,366.**—Amalgamating apparatus for crushed ores and like reduced bodies. William W. Fyfe, London, England.

**480,376.**—Process of making tanning extracts. Walton C. Tiffany, New York, N. Y.

Canaigre root is macerated in water at 140° F. and the infusion evaporated in vacuum.

**480,381.**—Combined cement mill and furnace. Henry H. Bourne, Trinidad, Col.

**480,384.**—Galvanic battery. Herbert H. Dow, Midland, Mich.

**480,405.**—Process of treating ores containing hydrated sesquioxide of iron. Clemens Jones, Easton, Pa.

**480,416.**—Art of desilverizing argentiferous lead. Heinrich Roessler, Frankfort-on-the-Main, Germany.

The lead is fused with an alloy of zinc and aluminium in the proportions of not more than one-half of one per cent. of aluminium to the zinc.

**480,445.**—Aluminium alloy. Christopher F. Whitney, Newton, Mass.

An alloy of aluminium 80 per cent. or more; a malleable metal, such as copper, 12 per cent. or less, and a metal of high fusing point, such as nickel, eight per cent. or less.

**480,491.**—Electrolytic cell. Elisha B. Cutten, New York, N. Y.

**480,492.**—Method of electrolytically producing potassium chlorate. Elisha B. Cutten, New York, N. Y.

Magnesium chloride is electrolyzed in the presence of potassium chloride and slaked lime. A solution of magnesium chloride is placed in contact "with the cathode and potassium chloride, magnesium chloride, and slaked lime in contact with the anode, the said magnesium chloride being separated from said potassium chloride, magnesium chloride and slaked lime by a porous partition, and then electrolyzing, whereby potassium chlorate is produced at the anode and magnesia at the cathode."

**480,493.**—Method of electrolytically producing potassium chlorate. Elisha B. Cutten, New York, N. Y.

**480,502.**—Dyeing or scouring machine. John H. Lorimer, Philadelphia, Pa.

**480,549.**—Phosphate separator and screen washer. George R. Boaz, Tampa, Fla.

**480,554.**—Bleaching compound. William B. Brittingham, New York, N. Y.

A compound consisting of the tungstate of an alkali combined with a hypochlorite.

**480,571.**—Diffusion apparatus. Samuel Faron, Pahala, Kau, Hawaii.

**480,575.**—Electric accumulator. Giovanni Gandini, Lodi, Italy.

**480,591.**—Composition of matter for the manufacture of artificial stone. Joseph E. Keseling and Charles Fuchs, Jr., New York, N. Y.

Consists of a basic cement of oxide of magnesium and neutral chloride of magnesium, asphaltum, and sand or analogous material.

**480,624.**—Fumigator. John T. Phelan, Cambridge, Mass.

**480,647.**—Quartz crusher. Andreas P. Anderson, Oriental, Nev.

**480,669.**—Perfumed starch and process of making the same. Frederick C. Norfolk, Des Moines, Iowa.

Paraffin is saturated with perfume and added to ordinary dry starch. Borax is also added.

480,686.—Process of refining fume. Frank L. Bartlett, Portland, Me.

480,687.—Gelatinous food product. Richard B. Beaumont, Rutherford, N. J.

480,699.—Smelting furnace. John S. Oliver, Brooklyn, N. Y.

*Issued August 16, 1892.*

481,702.—Apparatus for reclaiming soda ash. Lewis D. Armstrong, Lock Haven, Pa.; Meylert M. Armstrong, administrator of Lewis D. Armstrong.

480,761.—Stone and ore crushing machine. Edgar H. Booth, San Francisco, Cal.

480,770.—Paper making machine. Edward E. Johnson, Seneca Falls, N. Y.

480,812.—Diffusion apparatus. Edward F. Dyer and Harold P. Dyer, Cleveland, Ohio.

480,840.—Soap. Henry J. Echer and George F. Echer, Philadelphia, Pa. A soap composed of water, white soap, oxide of iron and pulverized quartz.

480,842.—Distilling apparatus. Alfred Feldmann, Bremen, Germany.

480,860.—Ore concentrator. Philip R. Stanhope, Dumont, Col., and Frank Wood, Brooklyn, N. Y.

480,883.—Storage battery. Edward P. Usher, Grafton, Mass.

480,884.—Battery cell. Edward P. Usher, Grafton, Mass.

480,885.—Storage battery. Edward P. Usher, Grafton, Mass.

480,886. } Battery plates. Edward P. Usher, Grafton, Mass.

480,887. }

480,891.—Temperature regulating device for electrical circuits. Edward Weston, Newark, N. J.

480,892.—Rheostat. Edward Weston, Newark, N. J.

480,893.—Rheostat. Edward Weston, Newark, N. J.

480,894.

480,895. } Electrical measuring instrument. Edward Weston,

480,896. } Newark, N. J.

480,897-98-99. }

480,912.—Machine for re-pressing bricks. William W. Wallace and Raymond C. Penfield, Willoughby, Ohio.

480,919.—Apparatus for manufacturing gas. Walter P. Elliott, New York, N. Y.

480,920.—Process of recovering tin from tin plate. Manuel R. Garcia, London, England.

480,928.—Heater and cooler for fermented malt liquors. John H. Kersenbrock, Columbus, Neb.

480,934.—Acid-resisting composition for lining tanks. Joshua Norton, Jr., Chatham, Canada.

"A lining of a digester composed of three superimposed layers or coats, the first consisting of hydraulic cement and other refractory material applied to the metal of the digester, the second containing hydraulic cement mingled with pulverized firebrick and other refractory material and imposed upon the first, and the third containing hydraulic cement and refractory materials upon the second."

**480,935.** } Brick kilns. James W. Penfield, Willoughby, Ohio.  
**480,936.** }

**480,940.**—Brick kiln. William H. B. Stout, Chicago, Ill.

**480,956.**—Process of treating base brelliar amalgam. Bernard Moebius, New York, N. Y.

The amalgam is charged into an "apparatus for distilling off and collecting the mercury, subjecting the heated charge to a comminuting action, while at the same time oxidizing the base metals by a current of air, and leaching the finely divided residue by sulphuric acid."

**481,004.**—Apparatus for corroding lead. George D. Coleman, Chicago, Ill.

**481,005.**—Art of making lead protoxide. George D. Coleman, Chicago, Ill.

A quantity of comminuted lead in a state of agitation is subjected to the action of atmospheric air and water in a suitable vessel at a temperature of 75° to 150° Fahrenheit. The oxide is removed as fast as formed, and the lead replaced by a regulated supply of comminuted lead. The temperature is regulated by a proper inflow and outflow of water through the corroding vessel.

**481,006.**—Process of manufacturing white lead. George D. Coleman, Chicago, Ill.

"The art of making white lead by the agitation of lead in a comminuted state in the presence of water, air and carbonic acid, the same consisting in carrying on the process at a regulated temperature of from 75° to 150° F. and under a pressure of from fifteen to thirty pounds, and preventing by a flow of water an abnormal rise in such temperature," etc.

**481,007.**—Art of making white lead. George D. Coleman, Chicago, Ill.

**481,023.**—Transparent toy or puzzle picture and mode of producing the same. Wilhelm Grüne, Sr., Berlin, Germany.

**481,031.**—Art of amalgamating silver ore. Alexis Jouin, San Francisco, Cal.

**481,061.**—Fermenting process. Frederick W. Rueff, San Francisco, Ca.

**481,075.**—Electric battery. Peter Sterns, Charlottenburg, Germany.

**481,085.**—Heating and ventilating apparatus. Samuel W. Wayson, Detroit, Mich.

**481,088.**—Hydrocarbon burner. Ambrose Chaney and Edward T. Wires, Terre Haute, Ind.

**481,101.**—Ore concentrator. William H. H. Bowers, Denver, Col.

**481,108.**—Apparatus for the consumption of sewer gas. Jacob Eckhardt, St. Louis, Mo.

**481,109.**—Filtering or purifying feed water. James B. Edmiston, Liverpool, England.

**481,146.**—Refrigerating machine. Charles F. Miller, Lancaster, Pa.

**481,147.**—Apparatus for drying or cremating garbage and fecal matter. John H. Parke, Philadelphia, Pa.

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The fiber is successively bleached in baths of chloride of lime and sulphurous acid.

**481,438.**—Coal or ore jigger and washer. Sebastian Stutz, Pittsburg, Pa.



- 481,474.**—Magnetic separator. Gurdon Conkling, Glens Falls, N. Y.  
**481,499.**—Process of treating sulphide ores of zinc and lead. George T. Lewis, Philadelphia, Pa., and Carl V. Petrams, Camden, N. J.  
**481,500.**—Process of treating sulphide ores. George T. Lewis, Philadelphia, Pa., and Carl V. Petrams, Camden, N. J.  
**481,502.**—Purification of fatty substances. Jules Massignon, Paris, France.  
**481,516.**—Composition for softening enameled leather. Robert L. Tudor, Cincinnati, Ohio.  
**481,532.**—Pulverizer. George H. Smith, Chicago, Ill.

*Issued August 30, 1892.*

- 481,550.**—Ore washer and concentrator. Arthur L. Dana, Colorado Springs, Col.  
**481,560.**—Secondary battery. William W. Griscom, Haverford College, Pa.  
**481,578.**—Art of making artificial honey cells and combs. Edgar T. Mason and Maximilian Moskovits, Kansas City, Mo.  
**481,591.**—Process of dyeing with alizarin. Henri N. Schaeffer, Lowell, Mass.  
The cloth or fibre is first treated with a soluble modification of alizarin consisting of a soluble salt of boracic acid and alizarin and then with a mordant.  
**481,606.**—Filter. James M. Wasson, Peoria, Ill.  
**481,623.**—Apparatus for heating compressed air. Robert A. Parke, New York, N. Y.  
**481,664.**—Galvanic battery. William J. Engledue, Byfleet, England.  
**481,676.**—Apparatus for generating ozone. Christopher C. Sharp, Chicago, Ill.  
**481,680.**—Apparatus for treating the refuse of cities. Jacob J. Storer, East Orange, N. J.  
**481,683.**—Method of and apparatus for extracting gold and silver from their ores. Jonas W. Aylsworth, Orange, and Arthur C. Payne, Elizabeth, N. J.  
**481,685.**—Artificial musk and process of making the same. Albert Bauer, Gispersleben, near Erfurt, Germany.

An ether of "metacresol" or substituted phenols is mixed with metallic chloride, heated, mixed with water and the butylated cresolether isolated, resulting in an aromatic colorless liquid. The ether is then introduced into fuming nitric (or nitric and sulphuric) acid, heated, and then crystallized from a suitable solvent such as alcohol. The product is a white crystalline powder having the natural odor of musk and is a trinitro-derivative of the butylated or analogous metacresol.

481,687.—Malt drying kiln. Carl G. Bosch, Davenport, Iowa.

481,703.—Reverberatory smelting furnace. Henry Mathey, South Riverside, Cal.

481,838.—Impregnating liquids with gases. Ulrich Bachmann, Mission San José, Cal.

481,860.—Soap. John Gray and Abner Simmons, Corsicana, Tex.

481,869.—Basic lining. Jacob Reese, Pittsburg, Pa.

A mixture of previously highly fired, shrunk and indurated lime and an adhesive carbonaceous substance.

481,879.—Apparatus for rectifying glycerine. Robert O. Unglaub, Pendleton, England.

481,881.—Manufacture of iron and steel. James P. Witherson, Allegheny, Pa.

481,885.—Open hearth furnace. Henry Aiken, Pittsburg, Pa., Frederick W. Wood, Baltimore, Md., and Harry H. Campbell, Steelton, Pa.

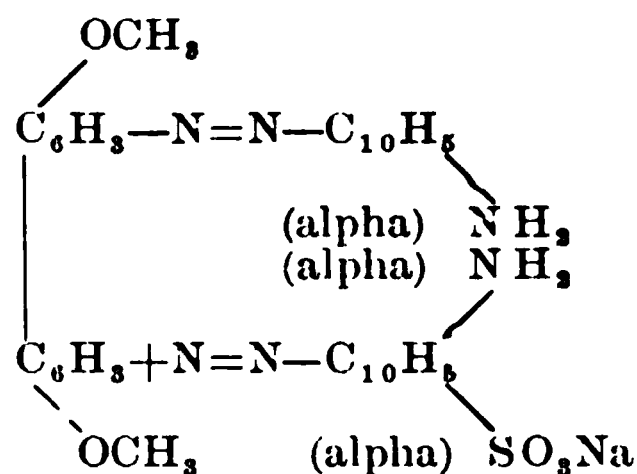
*Issued September 6, 1892.*

481,921.—Apparatus for cutting minerals. Llewelyn B. Atkinson and Henry W. Ravenshaw, London, and Frederick Mori, Leeds, England.

481,925.—Process for making whiskey. William E. Bradley, Frankfort, Ky.

481,934.—Red dye and process of making the same. Carl Dinsberg, Elberfeld, Germany.

The dyestuff has the formula



and is obtained by combining one molecular proportion of tetrazodiphenol ether with two molecular proportions of alpha-naphthylamine mono-sulpho-acid. It is a dark brown amorphous powder, easily soluble in water, with bluish red color; in sulphuric acid with deep blue color, the solution depositing deep blue flakes on the addition of sufficient water, leaving the supernatant liquid colorless.

481,949.—Composition of matter for journal bearings. Philip H. Holmes, Gardiner, Me.

The composition consists of plumbago, carbonized fibre, deposited carbon and an uncarbonized oil binder.

**481,950.**—Blast furnace. Malvern W. Iles, Denver, Col.

**481,955.**—Ammonia absorber. Frederick Kaiser, Knoxville, Tenn.

**481,958.**—Malting apparatus. Gustave A. Krause, Milwaukee, Wis.

**481,975.**—Meter for alternating electric currents. Oliver B. Schallenberges, Rochester, N. Y.

**481,979.**—Apparatus for electrically purifying water. Lucius T. Stanley, Brooklyn, N. Y.

**481,999.**—Electric furnace generator. Emile Berliner, Washington, D. C.

**482,001.**—Process of and apparatus for purifying, refining and carburizing metals. Benjamin Brazelle, St. Louis, Mo.

**482,012.**—Battery connector. Edward R. Knowles, Brooklyn, N. Y.

**482,018.**—Apparatus for purifying and refining alcoholic liquors and other liquids. Samuel Mason, Jr., Manchester, England.

**482,042.**—Apparatus for cutting and spreading glue. Charles Keller, Springdale, Pa.

**482,043.** ) Storage batteries. Patrick Kennedy and Charles J. Diss,

**482,044.** ( Brooklyn, N. Y.

**482,052.**—Apparatus for purifying sewage. John Wilson, New York, N. Y.

**482,053.**—Apparatus for purifying sewage. John Wilson, New York, N. Y.

**482,069.**—Feed water heater. John J. Wilson, Wahoo, Neb.

**482,076.**—Apparatus for heating water. Henry B. Clarke, Chicago, Ill.

**482,093.**—Rheostat. Harry W. Lawrence, Denver, Colo.

**482,101.**—Process of making disinfectants. Bruno R. Seifert, Radebeul, Germany.

A process for converting the difficultly soluble phenols into disinfecting mixtures which are easily soluble. "Crude carbolic acid" and phenols of a higher boiling point than carbolic acid are mixed "with water and with a metallic salt of an aromatic compound of the classes of aromatic acids and phenols."

**482,102.**—Disinfectant. Bruno R. Seifert, Radebeul, Germany.

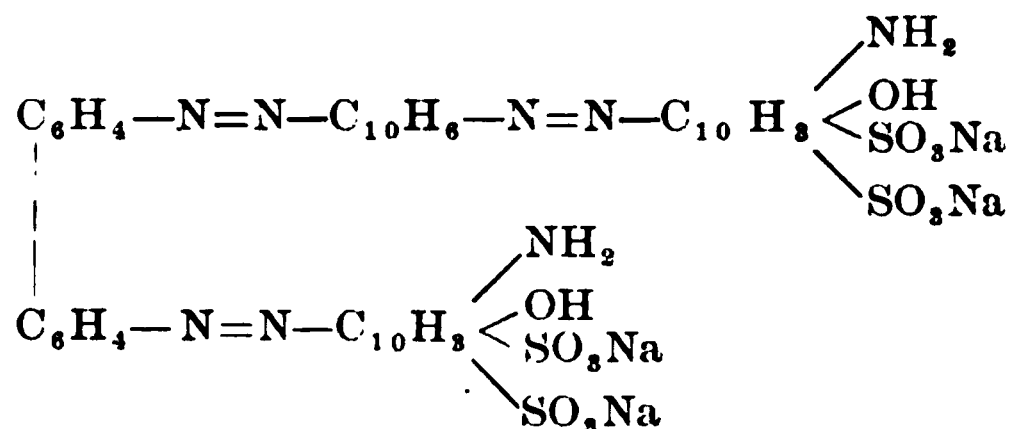
A disinfecting compound consisting of a mixture of cresol or matter containing cresol, such as crude carbolic acid and a metallic salt of an aromatic compound of the classes of aromatic acids and phenols.

**482,106.**—Azo coloring matter. Moritz Ulrich and Johannes Bammann, Eberfeld, Germany.

A blue direct dyeing coloring matter prepared "by combining one molecular proportion of tetrazo-diphenyl chloride with one molecular proportion of alpha-naphthylamine, by further diazotizing the thus formed intermediate product, and by subsequently combining the obtained hexazo

compound with two molecular proportions of the sodium salt of the 1.8 amido-naphthol betadisulpho-acid."

The dyestuff corresponds to the formula :



It produces a grayish-black powder easily soluble in hot water with dark blue color. This solution on the addition of acids deposits a dark blue precipitate. The dyestuff is soluble in solutions of sodium carbonate and ammonia with dark blue color, and in soda-lye with reddish-blue color, in conc. sulphuric acid with greenish-blue color separating a flaky blue precipitate on addition of an excess of water. Unmordanted cotton in alkaline soap bath is dyed greenish blue. The dyed cotton, if passed through an aqueous solution of sodium nitrite and diluted mineral acid, washed and placed in an alkaline solution of beta-naphthol, changes this greenish shade to black.

The dinitroso compounds of diphenylpiperazin, ditolylpiperazin, dixylylpiperazin, dinaphthylpiperazin, or the sulpho-acids or other substitution products thereof are treated with sulphurous acid, sulphur dioxide or alkaline bisulphites.

**482,108.**—Process of making piperazin. Paul Volkmann, Elberfeld, Germany.

**482,110.**—Apparatus or machine for cleaning bottles. George E. Wallace, Belfast, Me.

**482,117.**—Regenerative gas furnace. Friederich Danner, Tarentum, Pa.

**482,140.**—Filter. Bonifacio M. Santurio, Buenos Ayres, Argentine Republic.

**482,141.**—Gas purifier and condenser. Gottlieb Scharfe, Annapolis, Md.

**482,148.**—Telltale for electrolytic refineries. Francis B. Badt, Chicago, Ill.

**482,157.**—Electric arc lamp. John T. Birch, Pittsburg, Pa.

**482,176.**—Composition of matter. Philip H. Holmes, Gardiner, Me.

Plumbago and fibre are mixed, pressed, dried, immersed in oil and finally baked to carbonize both oil and fibre. Unmordanted cotton is dyed by it in a soap bath magnificently bluish red.

**482,179.**—Apparatus for washing sugar. Richard P. Johnson, Boston, Mass.

**482,183.**—Water circulator and purifier for steam boilers. James MacDonald, Los Angeles, Cal.

**482,184.**—Pulp engine. Guyon Miller, Downingtown, Pa.

**482,199.**—Process of finishing leather. John Sawzenbacher, Canfield, Ohio.

**482,205.**—Machine for preparing fibre. Harold Serrell, New York, N. Y.

**482,218.**—Process for reducing unsmelted ores. Jacob T. Wainwright, Chicago, Ill.

**482,233.**—Ammonia dipper valve. Jacob Dreisöner, St. Louis, Mo.

**482,249.**—Lubricant. Decatur Hammon, Ionia, Mich.

**482,252.**—Brick machine. George T. Jacobs, Washington, D. C.

**482,268.**—Refrigerating apparatus. Carleton W. Nason and Charles H. Leinert, New York, N. Y.

**482,310.**—Process of manufacturing composition journal bearings. Philip H. Holmes, Gardiner, Me.

**482,315.**—Air pump for condensers. Brun V. Nordberg, Milwaukee, Wis.

**482,322.**—Ore concentrator. Charles E. Seymour, Lake Geneva, Wis.

**482,323.**—Magnetic separator for ore concentrators. Charles E. Seymour, Lake Geneva, Wis.

**482,324.**—Electric meter. Francis Trague, London, England.

**11,267.**—Reissue. Manufacture of yellow dyes. Mainhard Hoffmann, Mainkur, Germany.

*Issued September 13, 1892.*

**482,330.**—Ore crusher and grinder. Nelson F. Acers, Kansas City, Mo.

**482,340.**—Apparatus for evaporating liquids. Charles W. Cooper, New York, N. Y.

**482,367.**—Composition of matter for artificial stone. Joseph E. Keseling and Charles Fuchs, Jr., New York, N. Y.

A basic cement made of chloride and oxide of magnesium, sand or analogous filling material, a solution of asphaltum and a solution of albumen and caseine.

**482,372.**—Process of recovering nitro-glycerin from waste acids. James Lawrence, Paulsbrough, N. J.

**482,396.**—Art of manufacturing sheet-iron. Benjamin Talbot, Chattanooga, Tenn.

**482,403.**—Insecticide. Joseph J. Carter, Alvin, Texas.

**482,425.**—Galvanic battery. Thomas T. Eckert, New York, N. Y.

**482,436.**—Filter. William M. Deutsch, Elizabeth, N. J.

**482,438.**—Process of reducing zinc. Christopher James, Swansea, England.

**482,444.**—Voltaic pile. William E. Washburn, Cedar Rapids, Iowa.

**482,477.**—Process of bleaching. Carl J. E. de Haën, List, Germany.

The goods are subjected to a bath of peroxide of sodium and a salt such as sulphate or chloride of magnesium.

**482,489.**—Apparatus for pickling metal plates. Daniel M. Somers and William H. Atkinson, Brooklyn, N. Y.

**482,508.**—Apparatus for burning oil. George H. Harvey, Pittsburgh, Pa.

**482,515.**—Apparatus for purifying water. James H. Blessing, Albany, N. Y.

**482,533.**—Fuse for explosive projectiles or shells. James C. Thompson, Brockley, England.

**482,537.**—Method of disintegrating vegetable substances. Henry J. Bird, Hoboken, N. J.

**482,445.**—Composition of matter for wall decoration. George A. Casselman, Fort Dodge, Iowa.

**482,549.**—Means for controlling electric generation. Thomas A. Edison, Menlo Park, N. J.

**482,552.**—Dental tool sterilizer. William G. Flanders, New York, N. Y.

**482,577.**—Composition of matter for the extraction of gold and silver from ores. Edward D. Kendall, Brooklyn, N. Y.

**482,581.**—Oil extracting apparatus. Charles Mann, New York, N. Y.

**482,582.**—Feeding device for ore washing machines. Carl A. E. Meinicke, Clausthal, Germany.

**482,583.**—Oil purifier and reservoir. Rudolph Metz, Philadelphia, Pa.

**482,586.**—Electrical furnace. Thomas Parker, Newbridge, England.

**482,596.**—Method for finishing bookbinders' cloth. Thomas A. and William H. Sutton, Salford, England.

**482,604.**—Method of producing an imitation of brocade or gold cloth. Franz P. Werner, Munich, Germany,

**482,661.**—Process of and apparatus for degreasing leather. Frederick N. Turney, Nottingham, England.

**482,667.**—Apparatus for the pasteurization of beer. Samuel S. Woodbury, Bradford, Pa.

**482,694.**—Ice machine. Magnus J. Palson, Gloucester, Mass.

*Issued September 20, 1892.*

**482,718.**—Composition coating for paper tubes. Sigmund Bergmann, New York, N. Y.

**482,724.**—Electrolytic apparatus. Thomas Craney, Bay City, Mich.

**482,738.**—Effervescent beverage. Olive M. Hechtman, Washington, D. C.

**482,795.**—Rock crusher. Horace L. Kent, Boston, Mass.

**482,823.**—Process of drying and disintegrating clay, etc. Franklin D. Cummer, Cleveland, Ohio.

- 482,834.**—Liquid fuel furnace. George Rose, Glasgow, Scotland.
- 482,841.**—Apparatus for the manufacture of aerated liquids. Luther G. and Swartz M. Chinnery, London, England.
- 482,842.**—Pressure regulator. George Harris, Chicago, Ill.
- 482,848.**—Apparatus for purifying and aging liquors. Christian Heintz, Buffalo, N. Y.
- 482,853.**—Ore separator. Horace H. Taylor, San Francisco, Cal.
- 482,855.**—Machine for decorticating wood. Abram Tilton, Brooklyn, and August Hormel, New York, N. Y.
- 482,876.**—Gas compressor for refrigerating machines. Bernhard H. Munsch, Hastedt, Germany.
- 482,879.**—Method of and apparatus for tempering wire. Fred Purdy, Englewood, Ill.
- 482,881.**—Apparatus for charging beer with carbonic acid. John B. Stobaeus, Newark, N. J.
- 482,893.** ) Bottle filling machines. George Claus, Jr., Elizabeth, and  
**482,894.** ) Albert M. Schomburg, Newark, N. J.
- 482,897.**—Method of making cheese. Johan D. Frederiksen, Little Falls, N. Y.
- 482,914.**—Bituminous rock reducing machine. John T. Cochran, Oakland, Cal.
- 482,920.**—Vapor burner. Harry S. Giles, Philadelphia, Pa.
- 482,960.**—Machine for combing fibrous material. Geo. E. Donisthorpe and Taylor Burrows, London, England.
- 482,979.**—Storage battery. Edward R. Knowles, Brooklyn, N. Y.
- 482,995.**—Process for extracting fat from wool. William T. Cutter, East Lyme, Conn.
- 483,003.**—Apparatus for carbureting air. James E. Mendenhall, Springfield, Ohio.
- 483,005.**—Apparatus for the manufacture of gas. Thomas McBride, Philadelphia, Pa.
- 483,018.**—Drying stove for bricks or other materials. Albert Schaaf, Halle, Germany.
- 483,022.**—Apparatus for bleaching cane juice. August F. Slingerup, New Orleans, La.
- 483,063.**—Apparatus for making vinegar. Russell M. Hughes, Louisville, Ky.
- 483,067.**—Preparation for beverages. Adele S. Kiniger, Hannahfield, Lenzie, Scotland.
- 483,099.** ) Hydrocarbon burning apparatus. James H. Bullard, Spring-  
**483,100.** ) field, Mass.
- 483,107.**—Apparatus for making gas. Ira S. Elkins, New York, and Reinhold Bocklen, Brooklyn, N. Y.

*Issued September 27, 1892.*

- 483,124.**—Electric heater. Thomas Ahearn, Ottawa, Canada.
- 483,141.**—Process for purifying tannic extracts. Georges Delvaux, Montigny-on-the-Loing, France.
- 483,143.**—Composition of matter for cleaning brownstone, etc. Henry J. and George A. Echer, Philadelphia, Pa.
- 483,148.**—Oil filter. John S. Hall, New York, N. Y.
- 483,168.**—Method of measuring the strength of magnets. Charles H. Rudd, Evanston, Ill.
- 483,176.**—Device for collecting metallic fumes. Dennis Sheedy and Malvern W. Iles, Denver, Col.
- 483,179.**—Art of making composite millstones. Thomas L. Sturtevant, Framingham, Mass.
- 483,230.**—Filter. Charles C. Lockstaedt and John F. Gubbins, Chicago, Ill.
- 483,237.**—Smoke consuming furnace. William Oehlstrom, Cleveland, Ohio.
- 483,245.**—Process for separating tin from other metals. Iras A. F. Bang and Marie C. A. Ruffin, Paris, France.
- 483,259.**—Method and apparatus for aerating liquids. James H. Minto, Liverpool, England.
- 483,290.**—Process of making salicylaldehydealphaphenylmethyl hydrazine. Israel Roos, Frankfort-on-the-Main, Germany.
- 483,335.**—Apparatus for degumming silk or other fibers. William H. Whiteley, Darby, Pa.
- 483,337.**—Beverage of fermented and unfermented wort and process of making the same. Edwin Adam, Philadelphia, Pa.
- 483,338.**—Process of making malt beverages. Edwin Adam, Philadelphia, Pa.
- 483,339.**—Thermostat. Ira F. Beers and Frederic C. Beers, Elmira, New York.
- 483,352.**—Apparatus for heating boilers by gaseous fuel. James L. Hastings, Philadelphia, Pa.
- 483,368.**—Process of making azo colors. Daniel A. Rosenstiehl, Paris, France.
- 483,395.**—Apparatus for cooling beer. Edward Seitz, Peoria, Ill.
- 483,397.**—Apparatus for cooling water in the manufacture of ice. Albert Smith, Colorado Springs, Col.
- 483,446.**—Ink. Charles M. Higgins, Brooklyn, N. Y.
- 483,447.**—Ink. Charles M. Higgins, Brooklyn, N. Y.
- 483,451.**—Waterproof composition. Sylvester Huff, Wabash, Ind.
- 483,452.**—Apparatus for treating phosphate rock. Samuel Hughes and William B. Chisholm, Charleston, S. C.



**483,484.**—Fumigator. Ferdinand Hoffman, Byron, Cal.

**483,489.**—Manufacture of gas. Robert M. Bidelman, Adrian, Mich.

**483,500.**—Refrigerating apparatus. Charles E. Pierce, Altamonte Springs, Fla.

**483,516.**—Pressure regulator. Van H. Higgins and Wm. D. Smith, Chicago, Ill.

**483,517.**—Mercurial gas governor. Van H. Higgins and William D. Smith, Chicago, Ill.

J. F. G.

NOVEMBER MEETING, Nov. 4th, 1892.

The regular meeting was called to order at 8:30 p. m. in the Law Lecture Room of the University. Prof. A. A. Breneman in the chair.

The minutes of the preceding meeting were read and accepted.

The following members were elected :

Frank N. Atwood, N. Y. Tartar Co., Brooklyn, N. Y.

Isador DePauw, H. W. Johns Mf'g Co., foot of 39th St., Brooklyn.

Prof. L. W. Andrews, Univ. of Iowa, Iowa City, Iowa.

Joseph Kessling, 525 W. 24th St., N. Y.

Prof. M. D. Sohon, Lehigh Univ., South Bethlehem, Pa.

As associate member.

Chas. S. Bush, Providence, R. I.

The Corresponding Secretary reported that the vote by mail on the new constitution had resulted as follows: 153 in favor of the constitution, 4 against, 3 in favor excepting certain sections, 1 ambiguous.

Those present who had not voted were given an opportunity to do so.

The chair then announced the new constitution as accepted.

It was moved and seconded that the report on spelling and pronunciation of chemical terms be referred to the council to report at the General meeting at Rochester.

The Society was then adjourned.

DURAND WOODMAN,  
*Recording Secretary.*



## THE ALBUMINOIDS OF MAIZE.

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By DR. GEORGE ARCHBOLD.

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Under this heading it was my first intention to have read an elaborate paper on the subject; but time and circumstances at my command are such that this must be considered only preliminary; inasmuch as it involves a very important feature in the manufacture of starch from maize. According to published analyses of average corn which is used in the 22 principal factories engaged in the manufacture of starch, the total albuminoids consist of ten and one-half per cent. of the maize. This includes what is commonly known as gluten, or nitrogen-yielding products. In the usual methods of making corn starch, it has been found advisable to macerate the corn under water at varying temperatures, with a view of softening the corn, and at the same time putting it in such a condition that it can be ground into a pulpy mass, and that all except the cellulose can be disintegrated from the mass. It will be obvious that a certain amount of the albuminoids will escape a sieve or any mechanical method of separation. It will also be understood that the time required, varying from three days to a week, for the softening of the grain in question requires a temperature sufficient to resolve anything of an albuminoid nature itself into further compounds of a very complex nature. In view of these facts, I have tried to find by direct investigation of the pure corn whether or not these albuminoids have undergone a decomposition that would entitle me to form a true hypothesis of the solution in question. With this purpose, I have taken corn recently ground and reduced it to an impalpable powder, and have placed it in a sealed box and forced water into it, until the extract that came from it showed nothing upon evaporation in a platinum dish except the salts existing in the water and a portion of the soluble

salts that existed in the maize. This being done all at a temperature not exceeding  $70^{\circ}$  F., I have taken the total aqueous extract, which was neutral to litmus paper, and added alkali to it, which precipitated a flocculent mass, giving 16.7% of nitrogen. When this was collected and dried in the air, it gave many of the properties of diastase. The magma that was in the box above referred to, by which I made the extraction under pressure with water at  $70^{\circ}$  F., was further ground so that all except the cellulose would go through an 80 mesh sieve, by repeated washings at  $70^{\circ}$  F.; or until the magma contained nothing but pure cellulose, thereby having all that passed through the sieve in a state of suspension, namely the starch and the albuminoids contained in the corn treated that were soluble in water. I now added by degrees to the total that had gone through the sieve a solution of caustic soda of a gravity of  $8^{\circ}$  until it gave a coloration of a greenish yellow color. This was done in a beaker, and the result was that a flocculent precipitate of a brownish green color fell to the bottom, and the starch was held in suspension in the upper strata of the liquid. Unless sufficient alkali is added the starch will fall to the bottom. I drew off by the usual methods of siphoning and by a repeated washing with distilled water and obtained the starch practically pure. But this water when mixed together from the several washings of starch, contained an albuminoid, precipitated on neutralizing with hydrochloric acid as a light brown substance which, when dried at  $212^{\circ}$  F., or until it ceased to lose weight, gave 18% of nitrogen. The starch was practically pure. The substance underneath the strata of suspended starch which I have mentioned above, was of a greenish color, and contained only a small percentage of nitrogen. It appeared to be in part an insoluble soap, and contained most of the oils contained in the corn. Supposing that I had taken corn or maize from the steeps, and separated the starch by the means herein set forth, I would obtain different results and be able to gain nearly the same amount of nitrogen but would also separate substances of albuminoid nature, that I will submit to this Society later on. Now, under these circumstances, when commercial maize in the dried state, such as I submit herewith, is taken, and when the

experiments are carried out as I have stated, it will be found that only two definite albuminoid substances are obtained, one of which is thrown down by alkalies as a greenish precipitate, and the other soluble in alkalies, which precipitate is of a greenish color (except ammonia, which yields a white precipitate) and precipitated by acids. By the most careful methods used in various factories, the whole of the albuminoids that are soluble in alkali are never entirely washed out as will be shown in the various colorations in the starches found in the American market, which show the variation in composition.

# ANALYSES OF COM

No.	Pure Starch.	Fibre.	Gluten	Ash.	Moisture	Total.	Mean Polariscopic Observation.	MINERAL	
								Calcium Carbonate	Calcium Phosphate
1	96.250	None	None	0.098	3.650	100.000	96° 2+	0.090	0.008
2	95.821	None	None	0.100	4.079	100.000	95° 8+	0.100	-----
3	88.000	0.100	None	0.420	11.480	100.000	87° 9+	0.228	0.008
4	89.250	0.110	0.200	0.400	10.040	100.000	89° +	0.221	0.018
5	88.280	0.381	0.400	0.400	10.589	100.000	87° 9+	0.221	0.008
6	88.000	0.110	0.190	0.200	11.500	100.000	87° 9+	0.091	0.008
7	88.010	0.201	0.099	0.700	10.990	100.000	87° 5+	0.500	0.013
8	87.901	0.750	0.249	0.600	10.500	100.000	87° 8+	0.880	0.018
9	88.210	0.220	0.201	0.500	10.569	100.000	87° 9+	0.421	0.030
10	87.561	0.439	0.100	0.400	11.500	100.000	87° 3+	0.200	0.008
11	87.200	0.310	0.190	0.200	12.100	100.000	87° +	0.090	0.010
12	87.000	0.150	0.050	0.400	12.400	100.000	87° +	0.300	-----
13	87.000	0.250	---	1.800	11.150	100.000	87° +	1.311	0.012
14	87.000	0.327	0.423	1.000	11.250	100.000	87° +	0.822	0.018
15	86.920	0.750	0.280	0.800	11.250	100.000	86° 9+	0.621	0.008
16	86.725	0.211	0.198	0.820	12.248	100.000	86° 5+	0.420	0.018
17	86.500	0.721	0.280	0.800	11.699	100.000	86° 5+	0.590	0.018
18	86.520	0.750	0.110	1.120	11.500	100.000	86° 4+	0.801	0.018
19	87.260	0.421	0.480	0.600	11.239	100.000	87° +	0.860	0.017
20	87.260	0.800	0.831	0.600	11.459	100.000	87° +	0.821	0.016
21	87.520	0.330	0.410	1.400	10.340	100.000	87° +	0.831	0.020
22	87.258	1.010	0.912	1.549	9.276	100.000	86° 9+	1.251	0.011
23	80.900	0.211	0.150	1.100	12.639	100.000	85° 5+	0.621	0.118
24	86.821	0.411	0.519	1.000	11.249	100.000	86° +	0.721	0.018
25	86.250	0.231	0.301	1.000	12.228	100.000	86° +	0.681	0.012
26	86.225	0.120	0.555	1.000	12.100	100.000	86° +	0.725	0.014
27	86.225	1.100	0.825	1.100	11.250	100.000	85° 5+	0.791	0.081
28	87.110	0.501	0.389	1.479	10.521	100.000	87° +	1.010	0.081
29	87.234	1.100	0.481	0.800	10.385	100.000	86° 8+	0.541	0.031
30	87.210	0.110	0.210	1.000	11.470	100.000	87° +	0.782	0.018
31	87.250	0.110	0.009	0.800	11.831	100.000	87° +	0.521	0.018
32	87.110	0.280	0.831	0.400	11.929	100.000	85° 2+	0.158	0.018
33	80.521	0.988	0.216	0.800	11.530	100.000	85° 9+	0.590	0.011
34	85.430	1.120	0.800	1.400	11.250	100.000	84° +	0.922	0.019
35	82.250	1.120	0.750	1.510	14.870	100.000	82° +	0.821	0.060

## MIXED STARCHES.

No.	Starch.	Fibre.	Gluten	Borax	Soda	Calcium Carbonate	Moisture	Stearine.	Total
1	85.280	0.220	0.321	2.003	0.249	0.351	11.639	-----	100.000
2	85.221	0.530	0.889	21.350	0.820	0.330	11.389	0.531	100.000
3	79.225	0.811	0.381	1.959	0.110	0.331	16.713	0.520	100.000
4	80.250	0.521	0.430	2.275	0.225	0.500	14.289	0.560	100.000
5	79.210	0.810	0.421	7.000	0.120	0.110	11.848	0.931	100.000
6	80.921	1.121	0.725	5.450	0.821	-----	10.252	1.210	100.000

MERCIAL CORN STARCH.

IMPURITIES.			REMARKS.
Soda.	Calcium Sulphate	Sodium Chloride.	
faint trace			Superior quality of starch, being <i>four to five</i> times purer than average commercial starch.
0.179			A fair sample of commercial starch.
0.161			An average sample commercial starch.
0.171			An average commercial starch.
0.101			An average commercial starch.
0.187			A fair commercial starch.
0.202			An impure commercial starch.
0.359			Unfit for culinary use.
0.192			A poor sample of commercial starch.
0.100			A fair sample of commercial starch.
0.200			An average sample of <i>rice</i> starch.
0.277			Excess of caustic alkali.
0.160			An ordinary commercial starch.
0.171			A fair commercial sample.
0.182			A fair commercial sample.
0.192			Too impure for culinary use.
0.306			Too high in mineral matter for food.
0.223			Impure commercial sample—excess alkali.
0.263			Impure commercial sample—excess alkali.
0.321	0.228		A very impure starch, unfit for food.
0.287			Below standard of commercial purity.
0.361			A very impure starch, unfit for human food.
0.261			A very ordinary sample of starch.
0.206		0.100	Too high in mineral impurities for culinary use.
0.261			An impure commercial starch.
0.228			Too high in mineral impurities for food.
0.388			Too high in mineral impurities and alkali for food.
0.238			Imperfectly separated and impure.
0.220			A fair commercial sample with excess of alkali.
0.261			A very impure rice starch with excess of alkali.
0.224			A poor starch, strength killed by use of free alkali.
0.259			Very impure and imperfectly prepared.
0.459			Very impure and unfit for culinary purposes.
0.521		0.088	Contains an abnormal % alkali—unfit for food



## Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

(Issued October 4, 1892.)

**488,522.**—Fire extinguisher. Oscar J. Averell, New York, N. Y.

**488,532.**—Chloridizing muffle furnace. Hugh Calhan and Aaron M. Beam, Hot Springs, Ark.

**488,560.**—Method of affixing manufactured asbestos. Frederick W. Jaqui, Jr., Cleveland, O.

The manufactured asbestos is saturated with water or its equivalent, and while wet pressed upon the surface to be covered.

**488,562.** } Storage batteries. Edward R. Knowles, Birkley, N. Y.  
**488,568.** }

**488,565.**—Artificial marble. Jörgen G. Maardt, Copenhagen, Denmark.  
A composition consisting of burnt gypsum, potash, alum, magnesite, magnesium, chloride, burnt flint and water.

**488,570.**—Furnace. Lewis Metesser, New Orleans, La.

**488,577.** } Furnaces for treating steel. John Peddie, Pittsburg, Pa.  
**488,578.** }

**488,590.**—Process of and machine for manufacturing wadding from cellulose and cotton. Carl Waibel, Newstadt-on-the-Hardt, Bavaria, Germany.

**488,599.**—Oil filter. Edwin S. Breed, Paterson, N. J.

**488,607.**—Apparatus for dyeing. Edward J. Gerber, Paterson, N. J.

**488,634.**—Washing powder. Elizabeth F. O'Neal, Philadelphia, Pa.

**488,638.**—Brick kiln. Charles A. Snow, Brick Haven, Va.

**488,639.**—Process of treating copper and pyrites. Jules Strap, Paris, France.

**488,646.**—Process of making artificial mica sheets for electrical insulation. Arthur H. S. Dyer, Schenectady, N. Y.

**488,652.**—Process of reducing zinc. Christopher James, Swansea, England.

**488,653.**—Molding mica forms for electrical insulators. Charles W. Jefferson, Schenectady, N. Y.

**488,654.**—Galvanic battery. Harry T. Johnson, New York.

**488,663.**—Machine for moulding articles from plastic compounds. Henry C. Warren, Boston, Mass.

**488,701.**—Apparatus for the manufacture of transparent sheets of pyroxyline. Edmund N. Todd, Newark, N. J.

**488,709.**—Apparatus for making gun cotton. Joseph Beck, Thomasville, N. C., and Oscar A. Neuninger, Newark, N. J.

**488,716.**—Composition for stereotype plates. William A. Force, Brooklyn, N. Y.

A composition of about two and a half pounds of rubber, four pounds two and a half ounces each of plumbago, white lead and litharge, and six ounces of sulphur. Zinc and baryta may also be used.

**488,748.**—Apparatus for making malt. William A. Peters, San Francisco, Cal.

**488,752.**—Method of working heat generator. Jacob T. Wainwright, Pittsburg, Pa.

**488,758.** } Electrical heaters. Arthur E. Appleyard, Boston, Mass.  
**488,759.** }

**488,766.**—Process of extracting gold from its ores. Carl Moldenhauer, Frankfort-on-the-Main, Germany.

**488,782.**—Thermo-electric battery. Paul Giraud, Chantilly, France.

**488,817.**—Evaporating apparatus. Oscar B. Stillman, Natick, Mass.

**488,819.**—Hot air furnace. Robert Tate, Toronto, Canada.

**488,826.** } Process for lining digesters. Hermann Brungger, Cunners-  
**488,827.** } dorf, Germany.

**488,828.**—Digester. Hermann Brungger, Cunnersdorf, Germany.

**488,847.**—Pulp drainer. Gustav L. Jaeger, New York, N. Y.

**488,868.**—Furnace. Henry C. Platts, London, England.

**488,868.**—Method of polishing rice or other grains. George B. Prochaska, New Orleans, La.

**488,870.**—Apparatus for the manufacture of paper pulp. Robert N. Redwayne, Newcastle-on-Tyne, England.

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**488,924.**—Process of separating copper from cupriferous nickel ores. Thomas S. Hunt and James Douglas, New York, N. Y.

**488,934.**—Zinc furnace. Octavius Lamaghi, St. Louis, Mo.

**488,936.**—Furnace tap. Edward P. Mathewson, Pueblo, Col.

**488,942.**—Digester. Benjamin F. Radford, Hyde Park, Mass.

**488,962.**—Process of smelting complex silver ores. Christopher James, Swansea, England.

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**488,981.**—Process of and apparatus for the manufacture of gas. John L. Janeway, Phoenixville, and Ferdinand Logan, Corner Stores, Pa.

**488,985.**—Metallurgical furnace. George W. Bierer, Allegheny, Pa.

*(Issued October 11, 1892.)*

**484,016.**—Fume arrester. Malvern W. Iles and Dennis Sheedy, Denver, Col.

**484,017.**—Device for catching and saving fumes from metallurgical furnaces. Malvern W. Iles, Denver, Col.

**484,018.**—Blast furnace top. Malvern W. Iles, Denver, Col.

**484,020.**—Blast furnace. Malvern W. Iles, Denver, Col.

**484,021.**—Process of recovering metals from copper alloys. Malvern W. Iles, Denver, Col.

**484,024.**—Apparatus for bottling beer. John H. Kersenbrock, Columbus, Neb.

**484,025.**—Beer apparatus. John H. Kersenbrock, Columbus, Neb.

**484,038.**—Process of extracting nickel from ores. Thomas McFarlane, Ottawa, Canada.

First washing ores rich in sulphur to expel excess of sulphur, then mixing sodium chloride with the ore, recalcining until sulphur fumes cease to be given off and chlorine fumes appear and until ferrous chloride is eliminated. The ore is then leached with hot water to dissolve out the nickel and the solution is treated successively with weak alkali, sodium sulphide and strong alkali for the respective purposes of precipitating the iron, the copper and the nickel. The oxide of nickel is finally reduced to metallic nickel.

**484,078.**—Apparatus for charging portable fountains with carbonated beverages. Jacob F. Witteman, Yonkers, N. Y.

**484,080.**—Process of dyeing. Ernst Zilbseen, Crefeld, Germany.

**484,084.**—Anti-friction alloy. Turner D. Bottome, Hoosick, N. Y.

**484,096.**—Galvanic battery. John W. Hoffman, Chicago, Ill.

**484,114.**—Vapor burner. Joseph R. Sapp, Cuyahoga Falls, O.

**484,120.**—Secondary battery. William L. Silvey, Lima, O.

**484,134.**—Confectioner's kettle. William Prierly, Rochdale, England.

**489,161.**—Melting pot. Roger S. Pease, Rose, Minn.

**484,181.**—Basic-lined furnace. John H. Darby, Brynbo, England.

**484,182.**—Method of electrical refrigeration. Mark W. Dewey, Syracuse, N. Y.

**484,183.**—Electrical depositing meter. Thomas A. Edison, Llewellyn Park, N. J.

**484,184.** ) Manufacture of carbon filaments. Thomas A. Edison, Llew-

**484,185.** ) ellyn Park, N. J.

**484,249.**—Wooden liquid-containing vessel. James M. Schofield, Merced, N. J.

**484,269.**—Reduction of complex ores. William C. Wetherill, Joplin, Mo.

**484,286.**—Lining for Bessemer converters. Carl W. Bildt, Worcester, Mass.

**484,301.**—Method of pressing and drying plants, and presses adapted therefor. Richard H. Day, Philadelphia, Pa.

**484,819.**—Brick machine. George Isaacs, St. Louis, Mo.

**484,828.** ( Furnace for metallurgical purposes. John N. Lauth, St.

**484,829.** ( Louis, Mo.

**484,845.**—Process of treating cork. John T. Smith, New York, N. Y.

**484,354.**—Hydrocarbon lighting device. Frederick A. Cody and Lyman T. Hawton, Meriden, Conn.

**484,885.**—Battery compound. William Wright, New York, N. Y.

A dry granular composition prepared by “ subjecting sulphuric acid containing a metallic oxide and a chromium compound to a temperature of 275° Fahr. for fifteen minutes and spreading the same on a plate cooled to 60° Fahr. to become dry and granular.”

*(Issued October 18, 1892.)*

**484,888.**—Process of making ultramarine blue. Johann Büttel, Newark, N. J.

**484,416.**—Apparatus for refining metals by electricity. Charles R. Fletcher, Boston, Mass.

**484,452.**—Apparatus for separating molten materials of different specific gravity. Orrin B. Peck, Chicago, Ill.

**484,458.**—Fluid pressure regulator. Charles J. Rinderknecht, Indianapolis, Ind.

**484,465.**—Rotary water meter. Carl Schon, Toledo, Ohio.

**484,475.**—Apparatus for the manufacture of carbureted hydrogen. James W. Tallmadge, Albany, N. Y.

**484,476.**—Process of and apparatus for forming solid metal ingots. Arthur J. Thowless, Newark, N. J.

**484,521.**—Yellow dye stuff. Hans Küzel, Höchst, Germany.

“ A coloring matter derived from diamid-sulphone and oxycarbonic acid. An orange brown powder difficultly soluble in water; totally insoluble in chloroform, ligroin, bisulphide of carbon; soluble in solutions of alkalies, ether, ethyl and methyl alcohol, and most readily soluble in acetone.”

**484,585.**—Apparatus for electro-plating. Frank H. Howard, Irvington, N. J.

**484,546.**—Process of treating bisulphate of soda. Eugene J. Barbier, Paris, France.

**484,570.**—Process of separating matter from slag. Edwin C. Pohle, Denver, Col.

**484,579.**—Process of making cyanides. George T. Beilby, Stateford, Scotland.

Ammonia is brought into intimate contact with a liquid, fused mixture of anhydrous alkali, cyanide and carbon.

**484,595.**—Brick kiln. William A. Koneman, Chicago, Ill.

**484,596.**—Gas producer. William A. Koneman, Chicago, Ill.

**484,624.**—Apparatus for the manufacture of gas. Augustus L. Allen, Poughkeepsie, N. Y.

**484,631.**—Nitrogenous fertilizer, and process of making the same. John J. Dunne, Philadelphia, Pa.

**484,633.**—Middling purifier. Joshua H. Goodall, Castleford, England.

**484,659.**—Slag separator. John F. Keeper, Denver, Col.

**484,664.**—Apparatus for pickling and washing metal plates, etc. Geo. Mesta, Pittsburg, Pa.

**484,679.**—Fertilizing composition. James D. Simmons, Hagarstown, Ind.

Composed of ferrous sulphide, potassium sulphate, wood ashes and calcium phosphate.

**484,682.**—Centrifugal milk tester. Ralph Stoddard, Rutland, Vt.

**484,697.**—Blue dye. Rene Bohn, Mannheim, Germany.

A product of the combination of tetraalkyldianidobenzophenone with dihydroxynaphthalene, by an agent such as phosphorous oxychloride.

**484,704.**—Apparatus for the manufacture of metallic articles by electrolysis. Alexander S. Elmore, Leeds, England.

**484,714.**—Fireproof paint. Walter S. Hill, Boston, Mass.

Composed of zinc hydate, an alkaline salt, asbestos, white lead, linseed oil and a pigment.

**484,717.**—Dust collector. William Ince, Hayle, England.

**484,721.**—Carbureting apparatus. James J. Parris, Beaver Falls, Pa.

**484,730.**—Water gas generator. Reinhold Boeklin, Omaha, Neb.

*(Issued October 25, 1892.)*

**484,770.**—Converter. William A. Baldwin, New York, N. Y.

**484,774.**—Garbage drier and burner. Frederick Cain, St. Paul, Minn.

**484,777.**—Machine for shaping and moulding plastic materials. Oliver R. Chase, Boston, Mass.

**484,781.**—Filter. William M. Deutsch, Elizabeth, N. J.

**484,784.**—Steam-jacketed kettle. Stephen H. Emmens, London, England.

**484,785.**—Magneto-electric generator. Sydney Evershed, London, England.

**484,790.**—Apparatus for automatically compressing chocolate, etc. Paul Guerin, Paris, France.

**484,794.**—Roofing compound. Samuel Herbert, Detroit, Mich.

**484,821.**—Drying apparatus. Hannibal W. Rappleye, Philadelphia, Pa.

**484,823.**—Apparatus for purifying sewage. Ernest E. Scruby, Epping, England.

**484,831.**—Evaporating apparatus. Oscar B. Stillman, Natick, Mass.

**484,837.**—Incrustation preventer. William H. Wilson, Indianapolis, Ind.

**484,851.**—Paint mixer. Peter Faust, Brooklyn, N. Y.

**484,861.**—Apparatus for testing ores. Harrison B. Much, Chicago, Ill.

**484,869.**—Process of separating gold and other metals from their ores. George J. Atkins, London, England.

**484,875.**—Method of treating ores containing nickel. Jean de Coppet, Paris, France.

**484,877.**—Process of separating iron from ore. Henry H. Earnes, Baltimore County, Md.

**484,884.**—Grinding mill. Gustav Schock, New York, N. Y.

**484,889.**—Soda water apparatus. William H. Collins, Malden, Mass.

**484,896.**—Brick press. Joseph J. Kulage, St. Louis, Mo.

**484,897.**—Brick and tile machine. Joseph J. Kulage, St. Louis, Mo.

**484,901.**—Art of and apparatus for carbonating liquids. Carl A. Schneible, New York, and Joseph Schneible, Brooklyn, N. Y.

**484,910.**—Fruit evaporator. William C. Gilham, Morristown, O.

**484,913.**—Refrigerating apparatus. Daniel L. Holden, New York, N. Y.

**484,916.**—Method of separating butter from milk. Carl G. P. de Laval, Stockholm, Sweden.

**484,921.**—Process of making potassium carbonate. Peter Römer, Bernburg, Germany.

**484,927.**—Sterilizer for surgical instruments. Edward Boeckmann, St. Paul, Minn.

**484,933.**—Ore separator and amalgamator. Fred J. Hoyt, Chicago, Ill.

**484,942.**—Smelting and reducing plant. John Rourke, Denver, Col.

**484,946.**—Steam generator or evaporator. George W. Baird, U. S. Navy.

**484,949.**—Carbureter. John Clingman, Dayton, O.

**484,955.**—Liquid cooler. Horace C. Gardner, Chicago, Ill.

**484,959.**—Electro converter. Ludwig Guthman, Fort Wayne, Ind.

**484,963.**—Apparatus for and method of recovering waste alcohol from liquor casks. Michael Hickey, Boston, Mass.

**484,968.**—Apparatus for hardening strips of metal. John Logan and Milton H. Stevens, Waltham, Mass.

**484,983.**—Refrigerating compound. Willburt C. Trussell, Boston, Mass.

Composed of ammonium chloride, sodium bicarbonate, potassium permanganate, potassium nitrate, brine and ice.

**484,990.**—Electrolytic process and apparatus. Henry Blackman, New York, N. Y.



## THE ALBUMINOIDS OF MAIZE.

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By DR. GEORGE ARCHBOLD.

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Under this heading it was my first intention to have read an elaborate paper on the subject; but time and circumstances at my command are such that this must be considered only preliminary; inasmuch as it involves a very important feature in the manufacture of starch from maize. According to published analyses of average corn which is used in the 22 principal factories engaged in the manufacture of starch, the total albuminoids consist of ten and one-half per cent. of the maize. This includes what is commonly known as gluten, or nitrogen-yielding products. In the usual methods of making corn starch, it has been found advisable to macerate the corn under water at varying temperatures, with a view of softening the corn, and at the same time putting it in such a condition that it can be ground into a pulpy mass, and that all except the cellulose can be disintegrated from the mass. It will be obvious that a certain amount of the albuminoids will escape a sieve or any mechanical method of separation. It will also be understood that the time required, varying from three days to a week, for the softening of the grain in question requires a temperature sufficient to resolve anything of an albuminoid nature itself into further compounds of a very complex nature. In view of these facts, I have tried to find by direct investigation of the pure corn whether or not these albuminoids have undergone a decomposition that would entitle me to form a true hypothesis of the solution in question. With this purpose, I have taken corn recently ground and reduced it to an impalpable powder, and have placed it in a sealed box and forced water into it, until the extract that came from it showed nothing upon evaporation in a platinum dish except the salts existing in the water and a portion of the soluble



salts that existed in the maize. This being done all at a temperature not exceeding  $70^{\circ}$  F., I have taken the total aqueous extract, which was neutral to litmus paper, and added alkali to it, which precipitated a flocculent mass, giving 16.7% of nitrogen. When this was collected and dried in the air, it gave many of the properties of diastase. The magma that was in the box above referred to, by which I made the extraction under pressure with water at  $70^{\circ}$  F., was further ground so that all except the cellulose would go through an 80 mesh sieve, by repeated washings at  $70^{\circ}$  F.; or until the magma contained nothing but pure cellulose, thereby having all that passed through the sieve in a state of suspension, namely the starch and the albuminoids contained in the corn treated that were soluble in water. I now added by degrees to the total that had gone through the sieve a solution of caustic soda of a gravity of  $8^{\circ}$  until it gave a coloration of a greenish yellow color. This was done in a beaker, and the result was that a flocculent precipitate of a brownish green color fell to the bottom, and the starch was held in suspension in the upper strata of the liquid. Unless sufficient alkali is added the starch will fall to the bottom. I drew off by the usual methods of siphoning and by a repeated washing with distilled water and obtained the starch practically pure. But this water when mixed together from the several washings of starch, contained an albuminoid, precipitated on neutralizing with hydrochloric acid as a light brown substance which, when dried at  $212^{\circ}$  F., or until it ceased to lose weight, gave 18% of nitrogen. The starch was practically pure. The substance underneath the strata of suspended starch which I have mentioned above, was of a greenish color, and contained only a small percentage of nitrogen. It appeared to be in part an insoluble soap, and contained most of the oils contained in the corn. Supposing that I had taken corn or maize from the steeps, and separated the starch by the means herein set forth, I would obtain different results and be able to gain nearly the same amount of nitrogen but would also separate substances of albuminoid nature, that I will submit to this Society later on. Now, under these circumstances, when commercial maize in the dried state, such as I submit herewith, is taken, and when the

experiments are carried out as I have stated, it will be found that only two definite albuminoid substances are obtained, one of which is thrown down by alkalies as a greenish precipitate, and the other soluble in alkalies, which precipitate is of a greenish color (except ammonia, which yields a white precipitate) and precipitated by acids. By the most careful methods used in various factories, the whole of the albuminoids that are soluble in alkali are never entirely washed out as will be shown in the various colorations in the starches found in the American market, which show the variation in composition.

# ANALYSES OF COM

No	Pure Starch.	Fibre	Gluten	Ash.	Moisture.	Total.	Mean Polariscopic Observation.	MINERAL	
								Calcium Carbonate	Calcium Phosphate
1	96.250	None	None	0.098	3.650	100.000	96° 2+	0.090	0.008
2	95.921	None	None	0.100	4.079	100.000	95° 8+	0.100	.....
3	98.000	0.100	None	0.420	11.480	100.000	87° 9+	0.228	0.006
4	89.250	0.110	0.200	0.400	10.040	100.000	89° +	0.221	0.018
5	88.280	0.381	0.400	0.400	10.589	100.000	87° 9+	0.221	0.008
6	88.000	0.110	0.190	0.200	11.500	100.000	87° 9+	0.091	0.006
7	88.010	0.201	0.099	0.700	10.890	100.000	87° 5+	0.500	0.013
8	87.901	0.750	0.249	0.600	10.500	100.000	87° 8+	0.380	0.018
9	88.210	0.220	0.201	0.800	10.509	100.000	87° 9+	0.421	0.020
10	87.561	0.489	0.100	0.400	11.500	100.000	87° 3+	0.200	0.008
11	87.200	0.310	0.190	0.200	12.100	100.000	87° +	0.090	0.010
12	87.000	0.150	0.050	0.400	12.400	100.000	87° +	0.200	.....
13	87.000	0.250	.....	1.600	11.150	100.000	87° +	1.311	0.012
14	87.000	0.327	0.423	1.000	11.250	100.000	87° +	0.822	0.018
15	96.920	0.750	0.280	0.800	11.250	100.000	86° 9+	0.621	0.008
16	86.725	0.211	0.198	0.620	12.248	100.000	86° 5+	0.420	0.018
17	86.500	0.721	0.280	0.800	11.699	100.000	86° 5+	0.590	0.018
18	86.520	0.750	0.110	1.120	11.500	100.000	86° 4+	0.801	0.018
19	87.260	0.421	0.480	0.600	11.229	100.000	87° +	0.360	0.017
20	87.260	0.800	0.381	0.600	11.459	100.000	87° +	0.331	0.016
21	87.520	0.330	0.410	1.400	10.940	100.000	87° +	0.831	0.020
22	87.253	1.010	0.912	1.549	9.276	100.000	86° 9+	1.251	0.011
23	86.900	0.211	0.150	1.100	12.699	100.000	85° 5+	0.621	0.118
24	86.821	0.411	0.519	1.000	11.249	100.000	86° +	0.721	0.018
25	86.250	0.221	0.301	1.000	12.228	100.000	86° +	0.681	0.013
26	86.225	0.120	0.555	1.000	12.100	100.000	86° +	0.725	0.014
27	86.225	1.100	0.325	1.100	11.250	100.000	85° 5+	0.791	0.081
28	87.110	0.501	0.389	1.479	10.521	100.000	87° +	1.010	0.081
29	87.284	1.100	0.481	0.800	10.385	100.000	86° 8+	0.541	0.031
30	87.210	0.110	0.210	1.000	11.470	100.000	87° +	0.762	0.018
31	87.250	0.110	0.009	0.800	11.831	100.000	87° +	0.521	0.018
32	87.110	0.280	0.331	0.400	11.929	100.000	85° 2+	0.158	0.018
33	86.521	0.938	0.216	0.800	11.530	100.000	85° 9+	0.580	0.011
34	85.430	1.120	0.800	1.400	11.250	100.000	84° +	0.922	0.019
35	82.250	1.120	0.750	1.510	14.370	100.000	82° +	0.821	0.080

## MIXED STARCHES.

No.	Starch.	Fibre	Gluten	Horax	Soda	Calcium Carbonate	Moisture.	Stearine.	Total.
1	85.280	0.220	0.321	2.003	0.249	0.351	11.639	.....	100.000
2	85.231	0.590	0.389	21.350	0.320	0.380	11.839	0.521	100.000
3	79.225	0.811	0.381	1.959	0.110	0.331	16.713	0.520	100.000
4	80.250	0.521	0.430	2.275	0.225	0.500	14.239	0.560	100.000
5	79.210	0.310	0.421	7.000	0.120	0.110	11.848	0.931	100.000
6	80.921	1.121	0.723	5.450	0.321	.....	10.252	1.210	100.000

MERCIAL CORN STARCH.

IMPURITIES.			REMARKS.
Soda.	Calcium Sulphate	Sodium Chloride.	
faint trace			Superior quality of starch, being <i>four to five</i> times purer than average commercial starch.
0.179			A fair sample of commercial starch.
0.161			An average sample commercial starch.
0.171			An average commercial starch.
0.101			An average commercial starch.
0.187			A fair commercial starch.
0.202			An impure commercial starch.
0.359			Unfit for culinary use.
0.192			A poor sample of commercial starch.
0.100			A fair sample of commercial starch.
0.200			An average sample of <i>rice</i> starch.
0.277			Excess of caustic alkali.
0.160			An ordinary commercial starch.
0.171			A fair commercial sample.
0.182			A fair commercial sample.
0.192			Too impure for culinary use.
0.306			Too high in mineral matter for food.
0.223			Impure commercial sample—excess alkali.
0.263			Impure commercial sample—excess alkali.
0.321	0.228		A very impure starch, unfit for food.
0.287			Below standard of commercial purity.
0.361			A very impure starch, unfit for human food.
0.261			A very ordinary sample of starch.
0.206		0.100	Too high in mineral impurities for culinary use.
0.261			An impure commercial starch.
0.228			Too high in mineral impurities for food.
0.388			Too high in mineral impurities and alkali for food.
0.238			Imperfectly separated and impure.
0.220			A fair commercial sample with excess of alkali.
0.261			A very impure rice starch with excess of alkali.
0.224			A poor starch, strength killed by use of free alkali.
0.259			Very impure and imperfectly prepared.
0.459			Very impure and unfit for culinary purposes.
0.521		0.088	Contains an abnormal % alkali—unfit for food

## Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

(Issued October 4, 1892.)

**483,522.**—Fire extinguisher. Oscar J. Averell, New York, N. Y.

**483,532.**—Chloridizing muffle furnace. Hugh Calhan and Aaron M. Beam, Hot Springs, Ark.

**483,560.**—Method of affixing manufactured asbestos. Frederick W. Jaqui, Jr., Cleveland, O.

The manufactured asbestos is saturated with water or its equivalent, and while wet pressed upon the surface to be covered.

**483,562.** }  
**483,568.** } Storage batteries. Edward R. Knowles, Burkley, N. Y.

**483,565.**—Artificial marble. Jörgen G. Maardt, Copenhagen, Denmark.  
A composition consisting of burnt gypsum, potash, alum, magnesite, magnesium, chloride, burnt flint and water.

**483,570.**—Furnace. Lewis Metesser, New Orleans, La.

**483,577.** }  
**483,578.** } Furnaces for treating steel. John Peddie, Pittsburg, Pa.

**483,590.**—Process of and machine for manufacturing wadding from cellulose and cotton. Carl Waibel, Newstadt-on-the-Hardt, Bavaria, Germany.

**483,599.**—Oil filter. Edwin S. Breed, Paterson, N. J.

**483,607.**—Apparatus for dyeing. Edward J. Gerber, Paterson, N. J.

**483,634.**—Washing powder. Elizabeth F. O'Neal, Philadelphia, Pa.

**483,638.**—Brick kiln. Charles A. Snow, Brick Haven, Va.

**483,639.**—Process of treating copper and pyrites. Jules Strap, Paris, France.

**483,646.**—Process of making artificial mica sheets for electrical insulation. Arthur H. S. Dyer, Schenectady, N. Y.

**483,652.**—Process of reducing zinc. Christopher James, Swansea, England.

**483,653.**—Molding mica forms for electrical insulators. Charles W. Jefferson, Schenectady, N. Y.

**483,654.**—Galvanic battery. Harry T. Johnson, New York.

**483,663.**—Machine for moulding articles from plastic compounds. Henry C. Warren, Boston, Mass.

**483,701.**—Apparatus for the manufacture of transparent sheets of pyroxyline. Edmund N. Todd, Newark, N. J.

**488,709.**—Apparatus for making gun cotton. Joseph Beck, Thomasville, N. C., and Oscar A. Neuninger, Newark, N. J.

**488,716.**—Composition for stereotype plates. William A. Force, Brooklyn, N. Y.

A composition of about two and a half pounds of rubber, four pounds two and a half ounces each of plumbago, white lead and litharge, and six ounces of sulphur. Zinc and baryta may also be used.

**488,748.**—Apparatus for making malt. William A. Peters, San Francisco, Cal.

**488,752.**—Method of working heat generator. Jacob T. Wainwright, Pittsburg, Pa.

**488,758.** } Electrical heaters. Arthur E. Appleyard, Boston, Mass.  
**488,759.** }

**488,766.**—Process of extracting gold from its ores. Carl Moldenhauer, Frankfort-on-the-Main, Germany.

**488,782.**—Thermo-electric battery. Paul Giraud, Chantilly, France.

**488,817.**—Evaporating apparatus. Oscar B. Stillman, Natick, Mass.

**488,819.**—Hot air furnace. Robert Tate, Toronto, Canada.

**488,826.** } Process for lining digesters. Hermann Brungger, Cunners-  
**488,827.** } dorf, Germany.

**488,828.**—Digester. Hermann Brungger, Cunnersdorf, Germany.

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**484,017.**—Device for catching and saving fumes from metallurgical furnaces. Malvern W. Iles, Denver, Col.

**484,018.**—Blast furnace top. Malvern W. Iles, Denver, Col.

**484,020.**—Blast furnace. Malvern W. Iles, Denver, Col.

**484,021.**—Process of recovering metals from copper alloys. Malvern W. Iles, Denver, Col.

**484,024.**—Apparatus for bottling beer. John H. Kersenbrock, Columbus, Neb.

**484,025.**—Beer apparatus. John H. Kersenbrock, Columbus, Neb.

**484,033.**—Process of extracting nickel from ores. Thomas McFarlane, Ottawa, Canada.

First washing ores rich in sulphur to expel excess of sulphur, then mixing sodium chloride with the ore, recalcining until sulphur fumes cease to be given off and chlorine fumes appear and until ferrous chloride is eliminated. The ore is then leached with hot water to dissolve out the nickel and the solution is treated successively with weak alkali, sodium sulphide and strong alkali for the respective purposes of precipitating the iron, the copper and the nickel. The oxide of nickel is finally reduced to metallic nickel.

**484,078.**—Apparatus for charging portable fountains with carbonated beverages. Jacob F. Witteman, Yonkers, N. Y.

**484,080.**—Process of dyeing. Ernst Zilbseen, Crefeld, Germany.

**484,084.**—Anti-friction alloy. Turner D. Bottome, Hoosick, N. Y.

**484,096.**—Galvanic battery. John W. Hoffman, Chicago, Ill.

**484,114.**—Vapor burner. Joseph R. Sapp, Cuyahoga Falls, O.

**484,120.**—Secondary battery. William L. Silvey, Lima, O.

**484,134.**—Confectioner's kettle. William Prierly, Rochdale, England.

**489,161.**—Melting pot. Roger S. Pease, Rose, Minn.

**484,181.**—Basic-lined furnace. John H. Darby, Brymbo, England.

**484,182.**—Method of electrical refrigeration. Mark W. Dewey, Syracuse, N. Y.

**484,183.**—Electrical depositing meter. Thomas A. Edison, Llewellyn Park, N. J.

**484,184.** ) Manufacture of carbon filaments. Thomas A. Edison, Llew.

**484,185.** ) ellyn Park, N. J.

**484,249.**—Wooden liquid-containing vessel. James M. Schofield, Merced, N. J.

**484,269.**—Reduction of complex ores. William C. Wetherill, Joplin, Mo.

**484,286.**—Lining for Bessemer converters. Carl W. Bildt, Worcester, Mass.

**484,301.**—Method of pressing and drying plants, and presses adapted therefor. Richard H. Day, Philadelphia, Pa.

**484,319.**—Brick machine. George Isaacs, St. Louis, Mo.

**484,328.** ( Furnace for metallurgical purposes. John N. Lauth, St.

**484,329.** ( Louis, Mo.

**484,345.**—Process of treating cork. John T. Smith, New York, N. Y.

**484,354.**—Hydrocarbon lighting device. Frederick A. Cody and Lyman T. Hawton, Meriden, Conn.

**484,385.**—Battery compound. William Wright, New York, N. Y.

A dry granular composition prepared by “ subjecting sulphuric acid containing a metallic oxide and a chromium compound to a temperature of 275° Fahr. for fifteen minutes and spreading the same on a plate cooled to 60° Fahr. to become dry and granular.”

*(Issued October 18, 1892.)*

**484,388.**—Process of making ultramarine blue. Johann Büttel, Newark, N. J.

**484,416.**—Apparatus for refining metals by electricity. Charles R. Fletcher, Boston, Mass.

**484,452.**—Apparatus for separating molten materials of different specific gravity. Orrin B. Peck, Chicago, Ill.

**484,458.**—Fluid pressure regulator. Charles J. Rinderknecht, Indianapolis, Ind.

**484,465.**—Rotary water meter. Carl Schon, Toledo, Ohio.

**484,475.**—Apparatus for the manufacture of carbureted hydrogen. James W. Tallmadge, Albany, N. Y.

**484,476.**—Process of and apparatus for forming solid metal ingots. Arthur J. Thowless, Newark, N. J.

**484,521.**—Yellow dye stuff. Hans Küzel, Höchst, Germany.

“ A coloring matter derived from diamid-sulphone and oxycarbonic acid. An orange brown powder difficultly soluble in water; totally insoluble in chloroform, ligroin, bisulphide of carbon; soluble in solutions of alkalies, ether, ethyl and methyl alcohol, and most readily soluble in acetone.”

**484,535.**—Apparatus for electro-plating. Frank H. Howard, Irvington, N. J.

**484,546.**—Process of treating bisulphate of soda. Eugene J. Barbier, Paris, France.

**484,570.**—Process of separating matter from slag. Edwin C. Pohle, Denver, Col.

**484,579.**—Process of making cyanides. George T. Beilby, Stateford, Scotland.



Ammonia is brought into intimate contact with a liquid, fused mixture of anhydrous alkali, cyanide and carbon.

**484,595.**—Brick kiln. William A. Koneman, Chicago, Ill.

**484,596.**—Gas producer. William A. Koneman, Chicago, Ill.

**484,624.**—Apparatus for the manufacture of gas. Augustus L. Allen, Poughkeepsie, N. Y.

**484,631.**—Nitrogenous fertilizer, and process of making the same. John J. Dunne, Philadelphia, Pa.

**484,633.**—Middling purifier. Joshua H. Goodall, Castleford, England.

**484,659.**—Slag separator. John F. Keeper, Denver, Col.

**484,664.**—Apparatus for pickling and washing metal plates, etc. Geo. Mesta, Pittsburg, Pa.

**484,679.**—Fertilizing composition. James D. Simmons, Hagarstown, Ind.

Composed of ferrous sulphide, potassium sulphate, wood ashes and calcium phosphate.

**484,682.**—Centrifugal milk tester. Ralph Stoddard, Rutland, Vt.

**484,697.**—Blue dye. Rene Bohn, Mannheim, Germany.

A product of the combination of tetraalkyldiamidobenzophenone with dihydroxynaphthaline, by an agent such as phosphorous oxychloride.

**484,704.**—Apparatus for the manufacture of metallic articles by electrolysis. Alexander S. Elmore, Leeds, England.

**484,714.**—Fireproof paint. Walter S. Hill, Boston, Mass.

Composed of zinc hydate, an alkaline salt, asbestos, white lead, linseed oil and a pigment.

**484,717.**—Dust collector. William Ince, Hayle, England.

**484,721.**—Carbureting apparatus. James J. Parris, Beaver Falls, Pa.

**484,730.**—Water gas generator. Reinhold Boeklin, Omaha, Neb.

*(Issued October 25, 1892.)*

**484,770.**—Converter. William A. Baldwin, New York, N. Y.

**484,774.**—Garbage drier and burner. Frederick Cain, St. Paul, Minn.

**484,777.**—Machine for shaping and moulding plastic materials. Oliver R. Chase, Boston, Mass.

**484,781.**—Filter. William M. Deutsch, Elizabeth, N. J.

**484,784.**—Steam-jacketed kettle. Stephen H. Emmens, London, England.

**484,785.**—Magneto-electric generator. Sydney Evershed, London, England.

**484,790.**—Apparatus for automatically compressing chocolate, etc. Paul Guerin, Paris, France.

**484,794.**—Roofing compound. Samuel Herbert, Detroit, Mich.

**484,821.**—Drying apparatus. Hannibal W. Rappleye, Philadelphia, Pa.

**484,823.**—Apparatus for purifying sewage. Ernest E. Scruby, Epping, England.

**484,831.**—Evaporating apparatus. Oscar B. Stillman, Natick, Mass.

**484,837.**—Incrustation preventer. William H. Wilson, Indianapolis, Ind.

**484,851.**—Paint mixer. Peter Faust, Brooklyn, N. Y.

**484,861.**—Apparatus for testing ores. Harrison B. Much, Chicago, Ill.

**484,869.**—Process of separating gold and other metals from their ores. George J. Atkins, London, England.

**484,875.**—Method of treating ores containing nickel. Jean de Coppet, Paris, France.

**484,877.**—Process of separating iron from ore. Henry H. Earnes, Baltimore County, Md.

**484,884.**—Grinding mill. Gustav Schock, New York, N. Y.

**484,889.**—Soda water apparatus. William H. Collins, Malden, Mass.

**484,896.**—Brick press. Joseph J. Kulage, St. Louis, Mo.

**484,897.**—Brick and tile machine. Joseph J. Kulage, St. Louis, Mo.

**484,901.**—Art of and apparatus for carbonating liquids. Carl A. Schneible, New York, and Joseph Schneible, Brooklyn, N. Y.

**484,910.**—Fruit evaporator. William C. Gilham, Morristown, O.

**484,913.**—Refrigerating apparatus. Daniel L. Holden, New York, N. Y.

**484,916.**—Method of separating butter from milk. Carl G. P. de Laval, Stockholm, Sweden.

**484,921.**—Process of making potassium carbonate. Peter Römer, Bernburg, Germany.

**484,927.**—Sterilizer for surgical instruments. Edward Boeckmann, St. Paul, Minn.

**484,933.**—Ore separator and amalgamator. Fred J. Hoyt, Chicago, Ill.

**484,942.**—Smelting and reducing plant. John Rourke, Denver, Col.

**484,946.**—Steam generator or evaporator. George W. Baird, U. S. Navy.

**484,949.**—Carbureter. John Clingman, Dayton, O.

**484,955.**—Liquid cooler. Horace C. Gardner, Chicago, Ill.

**484,959.**—Electro converter. Ludwig Guthman, Fort Wayne, Ind.

**484,963.**—Apparatus for and method of recovering waste alcohol from liquor casks. Michael Hickey, Boston, Mass.

**484,968.**—Apparatus for hardening strips of metal. John Logan and Milton H. Stevens, Waltham, Mass.

**484,983.**—Refrigerating compound. Willburt C. Trussell, Boston, Mass.

Composed of ammonium chloride, sodium bicarbonate, potassium permanganate, potassium nitrate, brine and ice.

**484,990.**—Electrolytic process and apparatus. Henry Blackman, New York, N. Y.

**484,999.** } Paper pulp digester. Charles Curtis, Newton, Mass., and  
**485,000.** } Nathaniel M. Jones, Bangor, Me.

**485,004.**—Steam condenser and purifier. Rees W. Dugan, Covington, Ky.

**485,009.**—Apparatus for generating gas. Charles W. Isbell, New York, N. Y.

**485,012.**—Process of treating beer. Arnold Kreusler, Kreischerville, N. Y.

**485,013.**—Secondary battery. William Main, Brooklyn, N. Y.

**485,024.**—Faucet filter. George F. Aishton, Rochester, N. Y.

**485,026.**—Liquid measuring device. Walter H. Beecher, Cincinnati, O.

**485,035.**—Process of separating tin from tin plate waste. Hans C. W. Harrison, Lueneburg, Germany.

The tin waste is treated with a dilute mixture of sulphuric acid and nitric acid, and the solution finally transferred to a vessel containing a heated mixture of dilute nitric acid, whereby the tin is precipitated as stannic oxide.

**485,050.**—Apparatus for decanting bottles. Fritz Moog, Mulheim-on-the-Mosel, Germany.

**485,063.**—Process of producing paint pigment from ores. Noah B. Smith and Carl P. Ludwig, Birmingham, Ala.

**485,069.**—Grinding pan. Albert J. Taylor, Silver City, Nev.

**485,075.** }

**485,076.** } Air or gas meter. Fred E. Youngs, Allegheny, Pa.

**485,089.**—Standard cell for electrical batteries. Henry S. Carhart, Ann Harbor, Mich.

**485,090.**—Apparatus for manufacturing pulp. John B. Carter, Kokimo, Ind.

**485,103.**—Match-heading composition. Jacob Klein, New York, N. Y.

Consists of dextrine water, phosphorus, minium, lamp black and nitric acid.

**485,113.**—Soap. Julius Niese, St. Louis, Mo.

Composed of common soap, powdered calcined bone dust, equal parts; about one-twentieth part of powdered sulphur.

**485,126.**—Apparatus for treating liquids with gases. George Lunge, Zurich, Switzerland.

**485,149.**—Apparatus for manufacturing ice. James Buckner, Boston, Mass.  
J. F. G.

REGULAR MEETING, DECEMBER 2d, 1892.

The regular meeting of the Society was called to order at 8:30 p. m. in the Law Lecture Room of the University. Prof. A. A. Breneman in the chair.

Prof. Johnson of Yale College a past President of this Society was present and was invited to take the chair, but asked to be excused in the interest of expediting the business of the meeting.

There were no new members elected. The following nomination to membership were made :

Robt. Heerlein, Natrona, Pa.

Pierre S. Du Pont, Wilmington, Del.

Cyril P. Mertens, Newark, N. J. (Roseville).

Chas. Platt, Vandenberg Laboratory, Buffalo, N. Y.

A paper on the "Albuminoids of Maize" was read by Dr. Geo. Archbold.

Discussed by Messrs. Johnson, Osborne, Geisler, Breneman, Waller.

A letter from Mr. T. D. O'Connor asking that his resignation which was before the Society should be acted on, was read. The resignation of Mr. O'Connor was accepted.

A circular letter from the American Philosophical Society of Philadelphia requesting that a delegation be sent to their 150th Anniversary to be held in Philadelphia, May 22-26, 1893, was read.

It was moved that Prof. Geo. F. Barker be asked to act as the delegate from the Society. Carried. The Corresponding Sec'y was instructed to notify Prof. Barker.

Dr. Bolton exhibited a printed card of the rules for spelling and pronunciation of chemical terms prepared by the U. S. Bureau of Education.

Prof. Hale reported that he had communicated with the members of the council in regard to a discussion of the rules of spelling and pronunciation at the Pittsburgh meeting, and had asked those who could not be present to send their views in writing. The meeting was then adjourned.

DURAND WOODMAN,  
*Recording Secretary.*

## THE PITTSBURGH MEETING.

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MINUTES OF ANNUAL MEETING held at PITTSBURGH, PA., Dec. 28th, 1892.

The meeting was called to order at 10:30 A. M., in the rooms of the Pittsburgh Academy of Arts and Sciences, by Professor A. H. Sabin, Chairman of the Committee of Arrangements.

The following papers were read :

I. "On Honey from the Aphis, or Plant Louse," by Dr. H. W. Wiley. Read by Prof. Sabin, in the absence of the author.

II. "Official Milk Analysis in Canada," by Prof. W. H. Ellis, Toronto, Canada.

III. "On the Effect of Decomposing Organic Matters on the Solubility of Natural Phosphates," by Prof. N. T. Lupton.

The paper was discussed by several members.

During the reading of papers Prof. Appleton arrived and was asked to take the chair. He was succeeded by the President, Prof. G. C. Caldwell. After the reading of papers, announcements were made in regard to excursions to be made by the Society, the first being to the Works of the Pa. Lead Co., and the Glass Works at Temperanceville.

The meeting was then adjourned to 8 P. M.

DURAND WOODMAN,  
*Recording Secretary.*

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### SECOND SESSION.

Called to order at 8 P. M. Dr. C. B. Dudley in the chair.

Prof. Caldwell delivered his address as President, on "The American Chemist: His Past and Present."

The Report of the Librarian was read and accepted. It was further ordered that its recommendations be referred to the incoming Board of Directors, with power to execute them.

Prof. Sabin here stated that a contribution to the Library had been received by him from Prof. F. H. Storer on the "Life and Works of the late Prof. Warren."

Prof. Hale then reported for the Committee on Elections; first in regard to the method of election adopted in the new constitution; and second, on the vote in favor of the new constitution.

In regard to the election of officers under the new constitution, he stated that a total of 191 ballots had been received, of which only 126 were strictly regular; 29 being behind the specified time, and 36 not signed. These irregularities, however, being proportional, the results were not affected by them.

The result of the election was as follows:

*President.*

H. W. WILEY.

*General Secretary,* A. C. HALE.

*Treasurer,* C. F. MCKENNA.

*Librarian,* ELWYN WALLER.

*Directors.*

For two years:

WM. MCMURTRIE,	A. A. BRENEMAN,
A. R. LEEDS,	A. H. SABIN.

For one year:

DURAND WOODMAN,	C. A. DOREMUS,
C. F. CHANDLER,	P. T. AUSTEN.

*Members of Council.*

For three years:

J. W. MALLETT,	G. C. CALDWELL,
A. B. PRESCOTT,	T. H. NORTON.

A question arose as to when the terms of office of the present officers expired. It was found that the new constitution provides

that all officers shall serve from the close of the annual meeting at which they are elected until the close of the following annual meeting or until their successors shall be chosen.

A paper was then read : " On Nickeliferous Pyrrhotite," by Dr. S. H. Emmens.

The paper was followed by some discussion.

It was announced that, in the morning, visits would be made to the Howard Plate Glass Works and the Duquesne and Homestead Works, and in the afternoon to the Pittsburgh Reduction Works and the Chambers Glass Works.

Prof. Morley then spoke, by invitation, on his work in determining the atomic weight of oxygen, describing his method of weighing, the degree of accuracy obtained, the difficulties surrounding the work, etc., etc.

A letter was read from Mr. H. C. Frick, President of the Coke Co. bearing his name, inviting the members to visit the Works.

On motion the meeting was then adjourned to 8 P. M., Dec. 29.

DURAND WOODMAN,

*Recording Secretary.*

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LAST SESSION.

DECEMBER 29th, 1892.

The meeting was called to order at 8:45 P. M. Prof. Edward Hart in the chair.

The reading of papers was taken up as the first order of business.

The following papers were read :

- I. " Problems in Physical Chemistry." By Prof. R. B. Warder.
- II. " On American Lithographic Stones." By Dr. C. W. Volney. Read by the Corresponding Secretary for the author.
- III. " The Composition of some Modern Powders." By Prof. C. E. Munroe.

A communication from J. F. Geisler, suggesting the adoption of a standard Table of Atomic Weights, was read by Prof. A. H. Sabin.

Prof. J. H. Appleton advised the appointment of a permanent committee on atomic weights, to report each year on a table for the acceptance of the society.

Prof. Munroe moved that a committee of one be appointed by the chair to report at the next annual meeting. The motion was seconded after some discussion.

The chair appointed Prof. F. W. Clarke.

It was moved and seconded that the report of the Committee of American Association for the Advancement of Science on Spelling and Pronunciation of Chemical Terms, which has been published by the National Bureau of Education, be adopted by the American Chemical Society.

Prof. Hale said, that if the matter was open for discussion formally, he would like to say a word or two in reference to the opinions of the different members of the Council to whom the matter was referred for their opinion. While in the main, some thought well of the report of the committee which was adopted by the A. A. A. S., yet there were criticisms both in regard to major and minor details.

The Chairman: "I suppose it will not be out of place as a member of the committee, the only member of the committee present at this meeting;—if I say that in view of the difference of opinion it seems to me desirable to take no action at all in the matter. My own view in all this committee's work is that we really ought not to appoint any one else to do or ask them to do anything that they do not feel perfectly free to do. In other words, we should be a deliberative body and not decide upon many things.

"It seems to me desirable that this feature should be insisted upon in all such meetings, and I for one have felt that in the American Association we depart entirely too far from that, I think—well established principle—so that for myself, I should not like to see anything of that kind adopted which would be felt as undesirable and irksome, even by one member of the American Chemical Society."

"Prof. Prescott suggested the other day that this would be a good subject for general discussion at the Congress of Chemists



to be held next year at Chicago. He seemed opposed to adopting anything formally by vote."

It was moved that this matter be laid on the table. Seconded and carried.

A vote of thanks was moved by Prof. Appleton as follows:—  
The Society hereby tenders its sincere thanks to many persons and corporations to whom it is indebted for invitations to visit works and for other attentions which have contributed to make the Pittsburgh meeting a most successful one: Especial recognition should be made of the kindness of the following persons and Companies :

Messrs. Hunt and Clapp.

Mr. Handy and Mr. R. M. Streaty.

The Academy of Art and Sciences.

The Engineers' Society of Western Pennsylvania, especially the chemical section.

The officers of the Pennsylvania Lead Co., especially Mr. Faunce.

The officers of the Duquesne Steel works, and of the Homestead Works, and especially Mr. Kent.

The officers of The Wightman Glass Co., the Howard Plate Glass Co., the Chambers Glass Co., the Pittsburgh Tin Plate Works, the Pittsburgh Reduction Co., and the H. C. Frick Coke Co.

The Corresponding Secretary read a list of about thirty-five nominations to membership awaiting action of the Council.

The Sixth Annual Meeting was then adjourned.

DURAND WOODMAN,

*Recording Secretary.*

## THE AMERICAN CHEMIST.

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BY PROF. G. C. CALDWELL.\*

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I have chosen for the subject of my address as retiring president of this society, one that seems appropriate to this occasion of the first gathering of a representation of American chemists on a fully organized basis as an American Chemical Society. My topic is the "American Chemist; his Past and Present;" and if I were but a prophet I would venture to add, his future. Even as a historian I can claim neither special gifts nor training, and what I may have to say must be regarded only as a contribution to the treatment of so large a subject.

The earlier records of the work of the American chemist are to be found only in periodicals of a general scientific character; for it is only within comparatively recent years, as we know, that he has been fortunate enough to have journals devoted exclusively to his own science. Before the establishment of these chemical journals, the *American Journal of Science and Arts*, better known as *Silliman's Journal*, contained almost the entire record of his work. Besides and before this were only Transactions of scientific societies to which, however, he was but a meagre contributor, with a few notable exceptions.

The oldest of these Transactions were those of the American Philosophical Society of Philadelphia; contemporaneous therewith was the New York Medical Repository. My history begins with what I can find in these periodicals or Transactions. Believing that the whole history can be presented in a more interesting manner if I divide the period over which it extends into distinct sub-periods, I will give my account of it by decades after and inclusive

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\* An address delivered by the retiring President of the American Chemical Society at the sixth general meeting, Pittsburg, Pa., December 28, 1892.

of the year 1800. What little there is on record of the American chemist's work prior to that year may be included in one period and set forth in a few words.

Of that time, just at the close of the last century, Dr. Priestley was the most prominent figure in chemical science. Indeed, if it had not been for his coming to this country, and his persistent devotion to the doctrine of phlogiston, and the opponents whom he aroused, there would have been exceedingly little to note of chemical work of any kind. As far back before this as 1769 a paper was read before the American Philosophical Society, and published in the first volume of the Transactions, entitled "An analysis of the chalybeate waters of Bristol in Pennsylvania," by one Dr. DeNormandie. This being, I think, the first chemical analysis made in this country, an account of it in the author's words will not be inappropriate. It runs as follows: Exp. (I.) "A small portion of white oak bark infused in the waters induced an immediate change from transparency to a dark purple color, which it retained twenty-four hours without depositing any sediment. (II.) Some of the same water after being made hot, or exposed for a few hours to the open air, in a great measure lost its irony taste, and received no other color than that of a common tincture from the white oak bark. (III.) One drop of strong oil of vitriol in two ounces of the water produced no sensible alteration; and the water after standing some time continued transparent, without depositing any okerish or other sediment to the sides. (IV.) Ol. Tart. pr. deliq. dropped in some of the same water induced a change of color, rendering it somewhat yellow, and in time precipitated to the bottom of the cup a fine gold colored oker. (V.) Sixteen ounces avoirdupois carefully evaporated to dryness in a china bowl in B. M. [*bain marie*, i. e., sand bath] left one grain of a yellowish brown powder of the taste of tart. tartariz. (VI.) Linen moistened with the scum floating on the top of the spring is tinged with a strong iron mould. (VII.) This water in weight is exactly the same as rain water. From these experiments it is sufficiently evident that this water in its natural state contains a large portion of iron dissolved in pure water by means of an acid, which acid is extremely volatile and of the vitriolic kind."

In another paper the author goes on to describe nine other experiments of the same sort, from which he concludes that his first deduction is confirmed that the water contains considerable iron, that the acid must be either vitriolic or nitrous, that there is a small portion of neutral salts in these waters, that they contain sulphur, and that they are slightly alkaline. The author then discusses the medical properties of the water, comparing it with the German Spa.

Nothing else appears till 1793 when there is published an account of an earthy substance found near Niagara Falls, and vulgarly called "spray of the falls."

We turn from such crude work as this, even though probably the best possible at the time and place, to that of Priestley, and his opponents, with a sense that we have hold of something of far greater importance, even if the main writer was all wrong in his theory. His first paper printed in this country appeared, I think, in 1796, in the same Transactions on "Experiments and observations relating to analysis of atmospheric air:" also further experiments relating to "Generation of air from water," the conclusion from which is that water is convertible into phlogisticated air. From this year on to the end of the century, he published numerous short articles in this periodical and in the New York Medical Repository.

In December, 1799, he read a paper before the American Philosophical Society on "Change of place in different forms of air through several interposing substances" and, says Dr. Bolton, "recognizes distinctly for the first time the phenomenon of gaseous diffusion." In the volume of the New York Medical Repository for 1798-9, he published eight letters to Dr. Mitchell defending the doctrine of phlogiston. In the same journal Dr. J. Woodhouse, Professor of Chemistry in the University of Pennsylvania, had many papers, from 1795 to 1800 and beyond, opposing Dr. Priestley's phlogistic views. What meagre showing this is, when we consider that, on the other side of the ocean, we find in the *Annales de Chimie*, the first volume of which appeared in 1789, such names of French chemists as Fourcroy, Lavoisier, Berthollet, Chaptal, Sennebier, Pelletier, Seguin, Vauquelin, Guyton

de Morveau and others, as contributors, from 1789 to 1800, of articles on the greatest variety of chemical subjects; qualitative and quantitative analyses of minerals and mineral waters, studies of the chemical properties of elements and of their compounds, the chemistry of plant life and animal life, proximate analyses of some organic substances, the preparation of pure salts of various kinds, the illuminating power of different oils, besides the discussions on phlogiston, which were of course a prominent feature in the chemical literature of that period, when this theory was receiving its death blows at the hands of Lavoisier. Books on chemistry were published, such as *Methode de Nomenclature Chimique*, *Traité de Chimie*, *Essai de Statique Chimique*, *System des Connaissances Chimique*, *Philosophie Chimique*; and in that same period the *Annales de Chimie* was started. In Germany there was Richter, author of *Anfangsgründen der Stöchiometrie*, *der Messkunst Chemischer Elemente*, and “*Ueber die neueren Gegenstände in der Chemie*,” in which he established by his own researches “the doctrine of proportions by weight, and showed that acids combined with bases to form salts, and developed the law of neutralization.” There was also Klaproth, the first Professor of Chemistry in the University of Berlin, who developed especially quantitative analysis, established by his improved methods the composition of many minerals, and discovered uranium, titanium and zirconium. In Sweden there was Scheele, who made a multitude of important contributions to chemistry, of which even a very imperfect enumeration would take too much of my time; and Bergmann, eminent as an analytical chemist and for his researches in analytical chemistry.

In England there was Cavendish who established the composition of water, and of nitric acid.

We pass on to the next decade, 1800–1809, when in England Sir Humphrey Davy first appeared prominently as a discoverer in chemistry, and published his account of the isolation of the metals potassium and sodium, and Dalton with his first developments of the atomic theory; when in Sweden there was the great Berzelius who, from 1807 on, devoted his entire energy to one great aim, the development of the atomic theory, and the first volume of

whose *Lehrbuch* appeared in 1808; in France, Gay Lussac who, in 1808, announced the law of combination of gases by volume; Thenard, beginning in 1807 his investigations on the compound ethers; and Proust (really in Madrid, whither he went from France) who, in the last year of the preceding decade, began his fight with Berthollet, contending for eight years for the constancy of proportion in the composition of chemical compounds.

Surely something of the spirit of this great work going on in Europe should begin to make itself felt across the Atlantic, even though the communication between the new world and the old was still so difficult, and narrowly limited. But there is practically nothing recorded in the only journals to which I have access, those already named, and there is good ground for believing that nothing important was done. Priestley was still contending for phlogiston with Dr. Morehouse and Dr. Mitchell, and performing some experiments of small account compared with what was being done abroad; such as "Observations on the discovery of nitre in common salt which had been previously mixed with snow," and "Transmission of acids, etc., in the form of vapor over several substances in hot tubes;" "Production of air by the freezing of water." Robert Hare, Jr., first appears in an "Account of fusion of strontites and volatilization of platinum," and B. Silliman in an "Analysis of a meteoric stone." Also, there is mention of perhaps the first soil analysis in America, under the title "On the substances which constitute the mineral soil of the environs of Boston."

All records fail me of any work done in the next decade, nothing being given in the above Transactions, till the appearance of Silliman's Journal in 1819; the eight short papers of that year, one of them by Dr. Hare, and the others by Silliman, only one to four pages each, and relating to unimportant topics, merit no further mention.

In the *twenties* over seventy papers of chemical import were given in Silliman's Journal, of which sixteen, mostly by Robert Hare, and very short with but four or five exceptions, referred to new forms of chemical apparatus or to reagents; seventeen, from one to seven pages in length, related to analyses of minerals; there

were two papers on the present state of chemical science and three on atomic weights, or points in chemical theory; other topics were generally of no special interest. In the Transactions of the American Philosophical Society, and in the Journal of the Franklin Institute which was started during this period, and the Proceedings of the Lyceum of Natural History of New York, were nine short papers, chiefly on analyses of minerals.

In the *thirties* about one hundred papers appeared in Silliman's Journal and the Journal of the Franklin Institute, nearly all of which were short—less than five pages long; but the character of the work, so far as indicated by the topics, was becoming higher; twenty-six papers related to studies of the properties of chemical elements or their inorganic compounds, and fifteen to studies in organic chemistry—none of them very deep perhaps, but still on a higher plane than heretofore; only fifteen related to analysis of minerals or mineral waters, six or eight to technical matters, and seven to analytical methods; the remainder were on miscellaneous topics, mostly of subordinate importance. About twenty-five of the whole number of papers were contributed by Dr. Robert Hare, many of them very short, and, as in previous years, on new forms of apparatus or new methods of preparation of substances, in the devising of which he appears to have been very ingenious. No other single writer was so prominent in the records of either this or the preceding decades.

In the *forties* (1848) a new periodical was added, the Transactions of the American Association for the Advancement of Science. Furthermore, original work in chemistry took a wonderful start; and well it might; for such names appeared, familiar enough to some of the oldest of us, if not to the younger men in my audience, as W. B. and R. E. Rogers, the first of whom afterwards took an important part in the organization of the Massachusetts Institute of Technology; J. Lawrence Smith, C. U. Shepard, John W. Draper, T. Sterry Hunt, E. N. Horsford and W. Gibbs, many of whom had received their inspiration in the laboratories of Germany. Smith studied under Orfila, Dumas and Liebig; Draper, a native of England, under Dr. Turner of the University of London; Horsford under Liebig; Dr. Gibbs under Rammelsberg, Rose, Liebig and Regnault.

Over a hundred papers appeared in the periodicals above named, and, while greater length does not necessarily mean much, nevertheless when papers of ten, fifteen, twenty pages or over, are the rule, rather than papers of two to four or five pages, it is not far out of the way to suppose that when such men as these I have named, and Silliman and Hare, write them, they are not made up of padding. Classifying these hundred or more papers roughly, about forty-three of them may properly be called purely scientific papers on inorganic chemistry, twenty on organic chemistry, twenty on analyses of minerals and waters, ten on analytical chemistry, and the rest on technical or other topics more removed from pure science. J. Lawrence Smith contributed eight of these papers; Hunt, ten; the Rogers brothers, eight. Dr. Hare was still prolific, contributing eight papers. Eight of the papers were purely theoretical; such as those on "The idea of an atom suggested by the phenomena of weight and temperature;" "Allotropism of chlorine as connected with the theory of substitution;" "Anomalies presented in the atomic volumes of phosphorous and nitrogen;" "Principles to be considered in chemical classification;" "Theory of compound salt radicals."

In the *fifties* about one hundred and seventy papers were published, against one hundred in the preceding decade, classified as follows: purely scientific, inorganic chemical work, about sixty; organic, eight; analytical, twenty-three; mineral analyses and studies, forty; technical subjects, nineteen; miscellaneous, eighteen. Several of these papers are theoretical studies; as, "Comparison between atomic weights and chemical and physical action of barium, strontium, calcium and magnesium, with some of their compounds;" "Numerical relations between the atomic weights, and some thoughts on the classification of the elements;" "Theoretical relation of water and hydrogen;" "Apparent perturbation of the law of definite proportions in compounds of zinc and of antimony;" "Rational constitution of certain organic compounds," etc. New and well-known names appearing prominently were those of Genth, Mallet, Cooke (J. P.), Brush and C. M. Warren. Robert Hare's name disappears. Cooke in his article, above mentioned, on the numerical relations between the



atomic weights, etc., classifies the elements in six series similar to the series of homologues in organic chemistry; in each series the difference between the successive atomic weights is a multiple of some whole number, this number being different for the different series. He shows that the properties of the elements in each series follow a law of progression; the numerical law for the progression in the specific gravity is given; and when a sufficient number of determinations shall have been made of such other properties as are capable of measurement, he predicts that numerical laws for each of these kinds of variation can be ascertained. Thus he looks forward to a perfect science of chemistry in which we shall be able to foretell with certainty the properties, not only of undiscovered elements in any given series, but also of the compounds of these elements. There are many correspondences between his classification and that of Mendelejeef, and as above shown, he foreshadows the idea, already realized with the aid of Mendelejeef's classification, of the possibility of locating and describing hitherto unknown elements. Hunt contributed seventeen of the papers, largely given to the analysis and constitution of minerals; indeed the examination of American minerals was a very prominent feature of the chemical work of this decade, as shown by the number of papers on the subject. J. Lawrence Smith and Mallet did the largest part of their work on this line, and the former made an important contribution to the methods of analysis of minerals, in his new process for the separation of the alkalies. It was in this decade, that the famous work appeared of Gibbs and Genth on the Ammoniao-Cobalt Bases, covering 59 quarto pages of the Smithsonian Contributions to Knowledge—the longest single article that had up to that time appeared on a chemical research. A redetermination of the atomic weight of lithium and of antimony was made by Mallet, the first work of this kind done by an American chemist. It may well be said that this is the first decade of chemical research in this country which has some prominent and important characteristics to distinguish it from the others that preceded it.

In the *sixties*, about two hundred and fifteen papers were pub-

lished, against one hundred and seventy in the fifties, of which ninety pertained to general inorganic chemistry; forty to organic chemistry, twenty-eight to methods of analysis and new forms of apparatus for analytical purposes; thirty to the analysis of minerals and mineral waters; seven were on technical subjects; fourteen on meteorites, four on agricultural chemical topics, and three on animal or vegetable physiological chemistry. More attention was given in this decade than in the preceding one to more purely scientific studies in general chemistry, for on inorganic and organic chemistry together there were one hundred and thirty papers, against only sixty-eight in the earlier period, while analyses of new minerals, also genuine scientific work, were almost as numerous as before. The most prominent contributor was Lea, nearly all of whose papers, over thirty in number, were on important topics in both inorganic and organic chemistry. Cooke and Horsford, of Harvard, and Gibbs and J. Lawrence Smith contributed important papers, as did also Hunt; Warren made some important contributions in organic chemistry. Other contributors were, Brush, Ordway, Crafts and Wetherill. Hinrichs first appeared with his theoretical essays, which some of us have perhaps attempted to master and assimilate. Of the papers on general inorganic and organic chemistry, about forty were from ten to thirty pages in length, indicating at least as to quantity of material to be communicated, research studies of considerable length. The proportion of such long papers was very much smaller in the preceding decades.

There is much work deserving special mention in this decade, such as Clark's "Constants of Nature," a collection of all the reliable determinations of specific gravities, boiling points, melting points, specific heats and expansion by heat, and covering 450 quarto pages of the Smithsonian Miscellaneous Collections; Warren's Monograph, of 100 quarto pages in The Transactions of the American Academy of Arts and Sciences, on "A new form of apparatus for fractional condensation of volatile liquids free from objections incident to the methods in use"; and "Researches on volatile hydrocarbons"; also, his papers on "A new method for combustion in a current of oxygen gas alone,

without the use of cupric oxide"; and on "The analysis of organic substances containing sulphur and chlorine."

As one result of his work on the hydrocarbons, Warren showed that the elevation of the boiling point for an increment of  $\text{CH}_2$  in homologous series is  $30^\circ$ , or much larger than was hitherto supposed; and that in certain other series derived from the benzole series, differences in boiling points for  $\text{CH}_2$  added or removed are much smaller than  $19^\circ$ , Kopp's figure.

Worthy of mention is Lea's attempt at a classification of the elements in several groups, the members of each group differing by 44-45, showing that "the elements thus grouped consist of bodies whose properties are analogous,—and that this classification is in harmony with the distinguishing characteristics of the substances classified." One such group starts with Sb, 120.3; As, 75; P, 31; N, 14; Sn, 59 and Pb, 103.5. Another comprises Hg, 200; Cd, 112; Zn, 65.5 and Mg, 24.4; all the members of this last group are in one of Mendeljéef's groups, and the first four members of the first group are also in another of Mendeljéef's. This grouping is founded on a broader basis; but Lea's was published thirty years ago, in 1860.

Gibbs showed by reference to the volumetric relation of gaseous compounds that if the proposed new atomic weights, 16, 12 and 32 be accepted for oxygen, carbon and sulphur, the atomic weights of least fifty other elements must be doubled; and as he is not a man to fail to give due credit to others, it is fair to infer that he was the first to call attention to this necessity. Lea's work on the ethyl bases as he calls them, diethylamine, triethylamine, etc., is comprised in several papers, in which he gives a very full account of their reactions, and a new method of separating them by picric acid. Ordway gave a very exhaustive paper on soluble glass, its chemistry and applications; Gibbs and Lea also made extensive researches on the platinum metals; and very notable are the many contributions made by Gibbs on improvements in methods of analysis; everything coming from his laboratory was reliable, and there was much of it. Hunt published three papers on the chemistry of mineral waters, in which, on the basis of certain general principles laid down, and of a number of analyses of waters

of the Champlain and St. Lawrence basins, he attempted to trace the history of these waters and account for their origin; and in another paper he attempted also to trace out the origin of the dolomites. Crafts, with Friedel, by results of research on the silicic ethers, proved as he thinks convincingly, the tetratomic character of silicium. Gaffield's interesting researches on the action of sunlight on glass were made in this decade. Gibbs made a very valuable contribution to the resources of physical chemistry, by a calculation of the wave lengths of the lines of a large number of the elements, from measurements made by Angström and Ditscheiner, and Huggin's scale of wave lengths of 1,000 lines. Goessman discussed in a careful and thorough manner the origin of the salt beds and the composition of the salt and the brine of the ocean water.

Three notable books appeared in this decade, Cooke's *Chemical Physics*, Storer's *Dictionary of Solubilities* and Wormley's *Microchemistry of Poisons*.

In the *seventies*, about two hundred and forty papers were published, a part of them in three new periodicals. The American Institute of Mining Engineers issued its first volume of *Transactions* in 1871. Methods of chemical analysis naturally occupied much of the attention of the chemical members of this Institute. The American Chemical Journal, and the Journal of the American Chemical Society made their first appearance in 1879. This Society was established in 1877, and published two volumes of *Transactions*, prior to the issue of the first volume of its Journal. Dr. Chandler's "American Chemist" also appeared in this decade.\*

Eighty of the papers published referred to general inorganic chemistry; forty-seven to organic chemistry; fifty-seven to analytical methods and apparatus; only thirteen to minerals and mineral waters, and the same to technical subjects; twenty-one short papers were on meteorites; agricultural chemistry had fourteen papers, physiological chemistry five, and sanitary chemistry two. Analytical chemistry was very much more prominent in the work of this decade, and in fact than at any time before it; methods of agricultural chemical analysis, as well as of analysis pertaining to the mining engineering interests, especially of iron and steel, re-

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\*This Journal was begun in July, 1870, and completed seven volumes, ending in 1876. It had been preceded by an American reprint of the English *Chemical News* with an American Supplement.

ceived special attention. The prominent contributors were M. C. Lea, J. Lawrence Smith, Gibbs, Remsen and Clarke; there were one hundred and thirty writers in all, of whom only fourteen contributed five or more papers, and only two, Lea and J. Lawrence Smith, contributed over ten papers; but many of these papers were short. In mass and importance of material published Gibbs, Clarke, Mallet and Remsen ranked as high as the more frequent contributors, especially if they receive the credit due them for work done in their laboratories, although published in the names of their assistants or students. The beginning of Chittenden's extended work in physiological chemistry appeared in this decade. Remsen, C. L. Jackson and A. Michael also became prominent as leaders in research in organic chemistry. Gooch, besides giving us his crucible for filtration, published a valuable work on the determination of phosphorus pentoxide. Gibbs began his long and difficult research on complex inorganic acids, of tungsten and molybdenum. Clarke traced out some new relations between the atomic volumes of the elements. Hilgard began his work on the methods of analysis of soils, in which he is now the universally recognized authority. J. W. Draper showed that the diagram given in so many works at that time, and occasionally even now, exhibiting unequal distribution of heat and actinism in the solar spectrum are misleading—that on the contrary the heat and chemical power are as great at one end of the spectrum as at the other, the diffraction spectrum showing no such inequality as the diagram represents. Lea continued his research on the action of light on silver salts and also made new determinations of the atomic weights of nickel and cobalt. J. Lawrence Smith established the presence of a solid hydrocarbon and free sulphur in meteorites. Cooke made new determinations of the atomic weight of antimony.

While there are single researches in the preceding decade of higher importance than any that appear in this, a careful comparison of the whole amount of work done might show that there was little difference in the real advance made in the two decades.

In the *eighties* we see an enormous advance in chemical work. One new chemical periodical appeared, the Journal of Analytical Chemistry.

Exclusive of papers on the examination of foods and drugs in the Reports of Boards of Health of three or four States, and of papers in Reports of Agricultural Experiment Stations, the whole number published was about eight hundred and seventy-five, and inclusive of papers excepted as above, the total would certainly not be less than nine hundred, or more than three and a half times as many as in the preceding decade. About one hundred and thirty of these papers related to general inorganic chemistry; two hundred and fifty-five to general organic chemistry; two hundred and eighty-three to analytical chemistry; over fifty to agricultural chemistry, twenty-five to technical chemistry; thirty to physiological chemistry; thirty-three to analyses of minerals and mineral waters, and also thirty-three, mostly very short papers, to analyses of meteorites. The amount of solid work on these several lines may be indicated in a measure by the length of the papers; a paper of one, two or even three pages, would as a general thing represent investigations of minor importance, and comparatively little actual work, although there may be some exceptions to the rule. Comparing in this respect the three leading lines of work, general inorganic chemistry, organic chemistry and analytical chemistry, about sixty per cent. of the papers in analytical chemistry are more than three pages long, while only twenty-two per cent. of the papers in inorganic chemistry, and nineteen per cent. of these in organic chemistry exceed that limit.

About three hundred and eighty chemists contributed these papers, of whom, however, two hundred and fifty-eight appeared but once or twice in the whole decade. The most frequent contributors were Clarke, Chittenden, Gibbs, H. B. Hill, Jackson, Morse, Michael, Mabery, Mallet, Remsen, E. F. Smith and Wiley; several valuable contributions were made by others, who published fewer papers, and in some cases very important ones.

The most notable feature in the work of this decade is the great amount of work in organic chemistry, done especially under the lead of Remsen, Jackson and Michael, most of which seemed to find its natural way to the public through Remsen's own journal. In these times when the *Berichte*, Liebig's *Annalen*, *Journal für Praktische Chemie*, *Monatshafte* and the *Journal of the English*

Chemical Society are giving us every year their fifteen hundred pages and more of papers on research in organic chemistry, there are at least some of us who are not only not conversant with this work, our lines of study being in other directions, but are each year getting more and more hopelessly out of touch with it. As one of those, I would not presume to pass judgment on the value of the researches in organic chemistry that are now being made in this country; but we can be confident that it is not such work as an American need be ashamed of; and I am sure we all rejoice that through these investigators our own country is contributing a large share of worthy research in this great branch of ical science.

In inorganic chemistry, Dr. Gibbs continued his work into this decade on the complex organic acids. Morley contributed his masterly papers on the analysis of air and his work on the atomic weight of oxygen; Becker, his digest of investigations on determinations of atomic weights since 1814, occupying 270 pages of the Smithsonian Miscellaneous Contributions to Knowledge; Clarke gave his recalculations of the atomic weights; M. C. Lea, his discovery of the allotropic forms of silver; Cooke and Richards, the redetermination of the atomic weights of oxygen and hydrogen; Mallet, his revision of the atomic weight of aluminum and determination of the molecular weight of hydrofluoric acid; Craft's, his determination of the vapor density of iodine, with results differing from those of both Deville and Troost, and Victor Meyer, and his paper on the vapor density of permanent gases; and Warder, some of the first beginnings of work on physical chemistry.

I have had pointed out to me by a competent authority as the most significant papers in organic chemistry, "Oxidation of substitution products of the aromatic hydrocarbons," and "Investigations on the sulphinides," by Remsen and his pupils; "Researches on the substituted benzyl compounds," by Jackson and his pupils; "Furfurol and its derivatives," by H. B. Hill, and "Researches on alloisomerism," by Michael and his pupils. Other leaders in this organic work were Mabery, L. M. Norton and W. A. Noyes.



In analytical chemistry nothing more prominent appeared than Mallet's most valuable and exhaustive work, in the Report of the lamentably short lived U. S. Board of Health, on "The determination of the organic matter in potable water" and Morley's on "The analysis of air." Analytical chemistry was much advanced along certain technical lines by the work of the Association of the Official Agricultural Chemists, begun in 1884, and by co-operative work on the analysis of iron and steel, published in the Transactions of the Institute of Mining Engineers.

In physiological chemistry, Chittenden continued with Ely and others the important work begun in the preceding decade, and published valuable papers on the digestive liquids and the products of their action on the proteids. In sanitary chemistry the work begun by the lamented Nichols in the seventies was carried further in this decade by Mallet in the paper on the determination of organic matter in potable water, already referred to, and the valuable papers by Leeds on potable water supplies, in Reports of the N. J. State Board of Health and the Journal of this Society. A large amount of work on the examination of foods and drugs was done under the supervision of the Boards of Health of a very few States, notably Massachusetts and New York, and of certain cities.

In agricultural chemistry, under the generous provision made by the U. S. Government by an Act passed in 1886, giving \$15,000 annually to every State in which an Agricultural College was established under the Act of 1862, and the no less generous provision made by some of the States themselves, a very large amount of work has been done. So close are the relations of chemistry to agriculture, that the opening and liberal equipment of a chemical laboratory for special work was among the first steps taken, on the establishment of each agricultural experiment station under this grant; thus at present a chemist, with often one or more assistants, is exclusively engaged in each State in agricultural chemical investigation. Under the liberal appropriation made also by the Department of Agriculture for chemical investigation, more liberal than by any other Government, a large amount of valuable work has been done at Washington. In the outcome



of these various provisions may be included Atwater's papers on the sources of the nitrogenous food of the plant, Richardson's on the composition of American cereal grains, the work of Jordan, Armsby and their associates on the digestibility and feeding value of fodder materials, and Hilgard's continuation of his work on soil analysis. Many papers were published on improvements in methods of agricultural chemical analysis, and a very large amount of routine work was done in the examination of commercial fertilizers for the purpose of protecting the consumers from fraud. In all this a prominent part was taken also in this decade by Johnson, Goessman, Jenkins, Babcock, Osborne and others.

Thus my history closes: a hurried one, and therefore imperfect, but nevertheless giving, I trust, something of an idea of what we have come to in this country, from very small beginnings. From about eighty papers in the twenties, the first decade in which any work of importance was done, to over nine hundred in the eighties is great progress: and the progress justly appears greater, when the character of the work is also taken into account. In the twenties the papers were mostly about the analysis of minerals, or new forms of apparatus or new reagents—and mostly very short papers—and in general much below the grade of work that was going on in Europe: in the eighties the work was on the same lines and of the same order as that done elsewhere, and, as well as that, rich in important results.

But there is room for further progress still, much of it, before we in this country shall accomplish as much as our brother chemists do in Europe; before our Chemical Society shall, if it publishes a journal, be able to send out annually such a volume as the Berlin Society does, to say nothing of what appears in other German periodicals.

What are our prospects, and what our means for doing this? This kind of work is done at the universities of Germany and her technical schools. We have universities; more of them, so-called, than Germany has; we have a few technical schools of a high order, and innumerable colleges. These universities and technical schools have their chemical laboratories, as have also many of the colleges. Every State has its agricultural experiment station,

with a working chemical laboratory. So far then, as concerns laboratories, and men in charge of them more or less specially educated as chemists, there is abundant provision. Every one of these universities, colleges and advanced technical schools has a double mission to perform, if it does the whole work that is expected elsewhere in the world, of institutions giving higher instruction. One of these missions is to teach—to impart knowledge that is already a part of the world's possession of knowledge, to the students who are seeking it, now in larger numbers than ever before. The other mission is to gain new knowledge—to add to the world's stock of it. Here and there is seen a man of wealth, and scientific tastes and acquirements, and an aptitude for research, who investigates in his own private laboratory, and does good work there; but such a combination is rare. These higher institutions of learning are to be in the future, as they have been in the past, the fittest places, and indeed almost the only places, for the making of both investigators and investigations.

Why is it, with so many of these institutions as we have, making claim to this high rank in our system of instruction, that we fall so far short of contributing our full share of the world's acquisition of new knowledge, year by year? The first and perhaps most important reason is that those upon whom this work devolves, and who would be glad to do it, have no time for it. Their work of instruction, often comprising many branches of science, uses up all their energy. This unfortunate condition of affairs is chargeable, to a large extent, to the multiplicity of colleges with endowments inadequate for the performance of the whole work of a college. It may be fairly said that no institution of learning is fully worthy of being called a university, or a college of high rank, that does not provide teachers enough, so that each one has spare time for investigation. There is room for improvement in this respect, even in some of our largest universities. It is not always practicable for an outsider, such as the average trustee is, to get so thorough an acquaintance with the inner workings of the several departments, as to understand how most of a teacher's time may be consumed in the management of the petty details of a laboratory full of students, provided that he does his duty there.

Secondly, given the time when this important feature of college and university comes to be properly appreciated, will there be means for the work. There can be little doubt that they will then be provided; if not in any other way, when it appears that there are men ready and competent to carry on valuable investigations, but who cannot for want of means and appliances, new funds for the promotion of such work may perhaps be added to those already in existence—such funds as the Elizabeth Thompson Science Fund, now amounting to \$26,000, the Bache Research Fund, and the Wolcott Gibbs Fund for chemical research.

Given time and means, have we the men in this country for creditable scientific research? I think that such an answer to this question as is indicated by the records of the chemical research in the decade from 1880 to 1890 is most encouraging. Great investigators like great poets, like men great in anything, are born not made; born, may we not truly say, out of the spirit of the country and the period in which their great works are done. But, when born they must be nurtured, and the place for their nurture is the university. In this sense the university must make the investigator as well as the investigation. In the land where the spirit of investigation is rife there will be the most material out of which to make investigators; and there too will men and women destined to be such be most sure to drift into the line of life work for which they are best adapted and receive the best training for it.

It seems to me that the relations of our Society to this matter of the furtherance of chemical investigation in this country are of vital importance; that if it does not appear in its stated meetings or the meetings of its sections scattered throughout the country, that it is alive with the spirit of research, it will fail to establish its reason for being; that membership of it will be of little advantage to anybody, and that the Society itself will be of little service to the country.

If I may be allowed a personal allusion I would say that it seems to me that in assuming membership of this Society I have also assumed a new duty: a duty to put forth special effort for the accomplishment of my share towards placing it on a par with other similar societies in its contributions to new scientific and technical

knowledge. If a spirit somewhat akin to this prevails amongst its members, both old and new, then shall we fully and honorably establish its reason for being.

It seems to me, further, that the evidence thereof will be looked for in the Journal of the Society; as we see in the *Berichte* the magnificent evidence for the reason for the existence of the Berlin Society; or, in the Journal of the English Chemical Society the evidence for the reason for the existence of that Society.

If most or even many of us feel no sense of a duty incumbent upon us to do earnestly whatever is in our power to advance the interests of this Society in the direction that I have indicated, and also to put into its journal a fair share of our testimony to this earnest endeavor, then I believe that our Society will lead a comparatively worthless life. It is my sincere hope that we may escape such a lamentable failure of our new efforts to establish an American Chemical Society worthy of its name.

## HONEY FROM THE APHIS OR PLANT LOUSE.

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BY DR. H. W. WILEY.

Contributions from the Chemical Laboratory of the U. S. Department of Agriculture. No. 1.

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Since the publication of my article on honey dew in the AMERICAN CHEMICAL JOURNAL, Vol. 13, pages 24 *et seq.*, I have had opportunity to examine several samples of honey collected by the bees from so called honey dew. Entomologists are not yet quite agreed in regard to the nature of honey dew, but most of them take the position that it is an exudation of the plant louse rather than an exudation from foliage which has been attacked by the plant louse. In other words the honey gathered from the plant louse has been twice digested, once in passing through the organism of the aphis, and once in passing through the organism of the bee.

In the examination of the pure honey dew collected from the trees, which is mentioned above, it was found that it contained a right-handed body having approximately a specific rotatory power of  $105^{\circ}$ , the rotation of arabinose. A sample of honey which was collected at the same time from the neighborhood, however, indicated that it was normal honey, showing that the bees did not store at least this sample of honey from the exudation above mentioned.

I had sent to me during the past summer a sample of honey with a statement that it was made by the bees gathering the honey from the plant louse. It had a right-handed polarization at a temperature of  $30^{\circ}$  of 23.10 divisions of the cane sugar scale and contained by inversion 5.21 per cent. of sucrose. In the dry substance it contained 71.58 per cent. of invert sugar, and the sum of the invert sugar and the sucrose, in the dry substance, was 77.62 per cent. It contained .62 per cent. of ash, making a total of 78.24 per cent. of solid matter by the determination of the invert sugar, the sucrose and the ash leaving 21.76 per cent. of solid matter presumably of the nature of the substance described in my first

paper. This sample of honey was polarized at  $88^{\circ}$ , at which temperature the invert sugar became optically neutral. Any excess of polarization, therefore, at that temperature must be due to the sucrose and other right-handed bodies present in excess or the dextrose and levulose or the invert sugar. The polarization at  $88^{\circ}$  of the sample under consideration was 40.30 divisions of the cane sugar scale. Deduct from this the polarization due to sucrose, namely, 5.21, and we have 35.09 divisions due to the rotation of the right-handed bodies in excess. This rotation must have been produced by the solid matter unaccounted for in the above analysis, namely, 21.76 per cent. Did this solid matter have the same specific rotatory power of cane sugar it would have polarized 21.76 divisions. If, on the other hand, it had the specific rotatory power mentioned above for the right-handed bodies, namely, 105, its polarization would be 34.9 divisions of the cane sugar scale which approximates very nearly to the actually observed polarization, namely, 35.09. Therefore it is certain that the right-handed body present in this sample is also one of the carbohydrates with a specific rotatory power of approximately 105, which confirms in every particular the results of the first investigation.

Unfortunately, the quantity of the sample which was sent me was only sufficient for the determinations mentioned, and therefore I did not have enough of the material to determine actually whether the substance present was arabinose or some other body or mixture of bodies with approximately the same specific rotatory power. I am promised, however, for next summer an abundant supply from the same source and I hope to be able to determine definitely the nature of this right-handed body.

Other samples of plant louse honey were also received by me and showed quite uniformly a slight right-handed rotation at ordinary temperatures, and also a marked deficiency of reducing sugar calculated as invert sugar. In every instance, also, so far observed, the percentage of ash in these plant louse honeys has been far above the average of the percentage of ash in pure floral honeys. The percentage of ash in six samples of honey, which were said to be of plant louse origin, are as follows seriatim : .62, .59, .79, .46, .78, .44.

It is true that in some samples of pure floral honey the percentage of ash approximates the percentage given, but in general it is very much less.

The three phenomena taken together, namely, right-handed polarization at ordinary temperatures, great deficiency in invert sugar, and high ash content appear to be, from the investigations so far made, analytical points by means of which a plant louse honey can be differentiated from a pure floral honey. It is understood, however, that the statement above made rests upon the analysis of six or eight samples of honey which, according to the reports received with the samples, were gathered largely from the exudations of the plant louse. An examination of a larger number of samples may show this dictum in regard to ash is not a reliable one, but the dicta respecting invert sugar and polarization are certainly correct. In other words, it appears possible, at the present time, to discriminate between a honey gathered by bees from exudations of plant lice and a pure floral honey extracted from the flowers themselves by the bees.

## THE EFFECT OF DECOMPOSING ORGANIC MATTER ON NATURAL PHOSPHATES.

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BY DR. N. T. LUPTON.

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. During the past few years especial attention has been called to the fertilizing value of natural or raw phosphates, when applied alone in the form of floats and when mixed with organic matter, such as cotton seed and cotton seed meal.

If floats can be shown to produce as good results as acidulated phosphates, which is claimed by some, the cost of commercial fertilizers ought to be greatly reduced and the extensive deposits of soft, aluminous phosphates found in Florida and elsewhere find a ready sale. While the results of experiments are somewhat conflicting, there appear to be conditions under which floats, or ground raw phosphates, do produce as good, if not better results, than acid phosphates. The presence of decomposing organic matter is generally regarded as one of these conditions, but chemists are not agreed as to the precise nature of its action.

Liebig, in his letters on "Modern Agriculture," published in 1859, advances the theory that organic matter undergoing decay accumulates carbonic acid in the soil, and when rain falls it dissolves the carbonic acid and thereby acquires the power of taking up phosphate of lime. This carbonic acid water does not withdraw from the soil the phosphate of lime contained in it, but wherever it meets with the granules of apatite or phosphorite, it dissolves a certain portion. Under these circumstances, a solution of phosphate of lime must consequently be formed, which spreads in all directions around each granule. Wherever this solution comes in contact with soil not already saturated with phosphate of lime, the soil will take up and retain a certain portion of this salt. The portion of soil now saturated with phosphate will oppose no further obstacle to the wider diffusion of the solution.



Voelcker (Bied. Centr. 1880—866, 867) as quoted in the Journal of the English Chemical Society, Vol. 24, Second Series, page 640, draws the following conclusions :

1. Phosphates are not readily taken up by plants in a soluble form, but must be returned to an insoluble condition before they yield their useful properties.

2. The efficacy of insoluble calcium phosphate corresponds with the minuteness of division in which it is found in a fertilizer.

3. The finer the particles in a phosphatic material, the more energetic its action as a manure.

Fleischer and Kissling (Bied. Centr. 1883—155, 161) on the application of insoluble phosphates to soils, found that the action of moorland soils when mixed with insoluble phosphates is to render a portion of the phosphate soluble in water, amounting to 5.5 per cent., in one case, of the total phosphoric acid ; a portion at the same time was reduced to the di-calcium salt, and in one compost heap as much as 17 per cent. of the total acid was brought into this form.

The general outcome of their experiments is that it is more advantageous to apply insoluble phosphate than superphosphate on humous soils, as they are capable of bringing insoluble phosphate into a soluble condition. This applies, however, only to peaty soils, as the presence of lime hinders this action.

In Volume 30 of the Journal of the Chemical Society, page 774, is an abstract of an article from the Journal of the Royal Agricultural Society, 1884, by Dyer, which states that the first experiments made in 1882 in a stiff clay soil containing no calcium carbonate, ground and unground coprolites were used. The comparison was made with swedes both with and without manure; in each case, the better result was from the undissolved phosphate. On the same plots, the following year, oats were grown without further addition of manure, and the produce was again, on an average, better where the undissolved phosphate had been employed. The following year 225 bushels of lime per acre were plowed in before sowing. The same quantities of manure were applied as before. The season was dry and the crop small, but in this case the produce was better where the dissolved phosphate

had been used. The ground coprolite contained more than twice as much phosphoric acid as the superphosphate.

Coming nearer home, we find that experiments made at the Alabama Agricultural Station are of similar import.

In Bulletin No. 22, new series, January, 1891, we find the following statement: "In several experiments previously conducted to ascertain the comparative agricultural value of the phosphate rock ground to impalpable powder, known as floats, with that of acidulated phosphate, the results have indicated that used in conjunction with cotton seed meal, floats are more profitable than the acid phosphate, taking into consideration the fact that floats contain nearly twice the percentage of phosphoric acid.

The soil used in these experiments was sandy drift that had been lying out many years. No commercial fertilizer had been previously applied to it."

To test more thoroughly the comparative productiveness of ground raw phosphate and acid phosphate under different conditions and to determine whether decomposing organic matter converts insoluble into soluble phosphate, two sets of experiments were carried out, one on the farm and the other in the chemical laboratory, the results of which will now be given.

The materials used were carefully analyzed by Dr. Anderson, assistant chemist, with the following results:

The acid phosphate used, gave

Water soluble phosphoric acid ( $P_2O_5$ )	----	9.10	per cent.
Citrate soluble	"	2.94	"
Acid soluble	"	2.32	"

Total phosphoric acid ( $P_2O_5$ )	----	14.36	"
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The Florida phosphate reduced to a fine powder, similar to floats, gave

Moisture	-----	4.18
Insoluble matter	-----	32.39
Total phosphoric acid ( <i>acid soluble</i> )	-----	16.54
Iron and aluminium oxides	-----	8.89

None of the lime phosphate was soluble in water and only 0.32

was soluble in ammonium citrate. The analysis shows an inferior grade of raw phosphate. The material purchased as "South Carolina floats" contained 2.26 per cent. of available phosphoric acid in the form of citrate soluble acid and a total phosphoric acid of 28.73 per cent. The available phosphoric acid in each of the materials used in the experiments may be stated as follows :

- |  |                |
|--|----------------|
| 1. Cotton seed meal, available acid ( $P_2O_5$ ) | 3.19 per cent. |
| 2. Cotton seed,                                  | " " 1.03 "     |
| 3. Florida raw phosphate,                        | " " 0.32 "     |
| 4. South Carolina floats,                        | " " 2.26 "     |
| 5. Acid phosphate,                               | " " 12.04 "    |

Two qualities of land were selected at the station for the field experiments, one a strong red soil, the other a poor sandy soil. The results obtained were as follows ; on the poor soil the fertilizers were sown broadcast :

		Lbs. Seed Cotton per acre.
No. 1	400 lbs. pulverized Florida phosphate.	290.5
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" 3	400 " acid phosphate	196.7
" 4	800 " " "	144.2
" 5	No fertilizer	106.4
" 6	400 lbs. Florida phosphate with 400 lbs. cotton seed meal	249.2
" 7	800 lbs. Florida phosphate with 800 lbs. cotton seed meal	322.7
" 8	400 lbs. acid phosphate with 400 lbs. cotton seed meal	252.0
" 9	800 lbs. acid phosphate with 800 lbs. cotton seed meal	320.6
" 10	No fertilizer	233.8

Each plot was one-seventh of an acre and the usual precautions were taken to remove disturbing elements and have the conditions of cultivation and growth as uniform as possible. The details of

the work were under the immediate supervision of Mr. Clayton, assistant agriculturist. On the strong red soil, the fertilizers were applied in the drill with results as follows:

		Lbs. Seed Cotton per acre.
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" 6	200 lbs. Florida phosphate with 400 lbs. cotton seed	919.2
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" 8	200 lbs. acid phosphate with 400 lbs. cotton seed	1178.4
" 9	400 lbs. acid phosphate with 800 lbs. cotton seed	1387.2
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" 12	400 " acid phosphate	975.2
" 13	400 " cotton seed meal	1271.2
" 14	800 " cotton seed	1294.4

The land was not uniform in natural productiveness but improved in quality from the first to the last plot. While the results are not perfectly uniform the pulverized raw phosphate evidently produced as good if not better results than the acid phosphate, whether used alone or mixed with cotton seed and cotton seed meal.

Anticipating these results, experiments were carried on in the

laboratory during the summer to determine whether they are due to the fact that decomposing organic matter converts insoluble or acid soluble lime phosphate into the available or citrate soluble condition. For this purpose, half-gallon, wide-mouthed glass jars were used and the following mixtures placed in each :

No. 1	2 lbs. Florida phosphate with ½ lb. cotton seed meal.
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“ 3	2 “ South Carolina floats “ “
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“ 7	2 “ South Carolina floats “ “
“ 8	1 “ “ “ “ “

The contents of each jar were rubbed up in a porcelain mortar moistened with water, and mixed as thoroughly as possible. The mixtures were stirred frequently, in fact nearly every day. Fermentation began within a day or two and continued during the whole period of the experiments. Samples for analysis, that is, for the determination of available phosphoric acid, were taken from the jars and analyzed with results as follows :

Date of taking		Per cent. of available $P_2O_5$ found.							
Sample.		1	2	3	4	5	6	7	8
July	2..	0.99	1.69	2.68	3.04	0.58	0.54	2.77	—
“	9..	1.25	1.62	2.89	2.64	0.72	0.95	2.33	2.27
“	16..	1.25	1.61	2.89	2.82	0.72	0.80	2.29	2.26
“	23..	1.16	1.80	3.37	3.22	0.84	0.49	2.37	2.39
“	30..	1.12	1.60	3.02	3.38	0.72	0.53	1.81	2.70
Aug.	6..	1.41	1.79	2.87	3.15	0.82	1.08	2.49	2.57
“	20..	1.41	1.57	2.73	3.26	0.81	1.00	2.15	2.53
Sept.	3..	1.50	2.16	2.75	3.27	1.16	1.10	1.96	2.51
“	17..	1.41	1.75	2.56	2.91	1.07	0.89	2.04	2.32
Oct.	1..	—	2.28	2.97	3.14	0.99	1.26	2.57	2.51

The above results seem to show that the fermentation of the

cotton seed and cotton seed meal had very little, if any, effect on the Florida ground phosphate or the South Carolina floats in converting the insoluble into soluble phosphate. The slight variation in the results, though favoring to some extent the conclusion that there is a slight increase in the available phosphoric acid, may be accounted for on the ground of personal error or the want of uniformity in the mixing of the materials, since it is difficult if not impossible to secure perfect uniformity in a mixture of ground phosphate and cotton seed.

AUBURN, Alabama, December, 1892.

## PROBLEMS OF PHYSICAL CHEMISTRY.\*

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By PROF. R. B. WARDER.

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We may distinguish, at least, four stages or kinds of scientific work, which may or may not be accomplished by the same investigator:

I. The observation and recording of facts; these may be quantitative, as the density of a gas, or qualitative, as the liquefaction of a vapor.

II. The compilation of related facts for further use (tables of constants, for example), together with the critical examination of the discrepancies and trustworthiness of observations.

III. Comparison and discussion of related facts. The observed facts may require reduction or computation in order to make them comparable; as when specific gravities are referred to water at different temperatures, or boiling points are observed under various pressures. Many determinations of speed of chemical action are on record, which have not yet been reduced to a uniform system of units.

IV. The tracing of generalized facts to their cause; first, by scientific use of the imagination in devising an hypothesis, then by subjecting it to the rigorous test of known facts or further experiments. Such was the brilliant work of O. E. Meyer on the kinetic theory of gases.

These various kinds of scientific activity demand very different degrees and kinds of ability; the field is broad and varied enough for all willing workers, even with quite moderate laboratories and libraries, if the work could be properly distributed.

The subject matter of physical chemistry may include all physical properties or phenomena of all kinds of matter in all possible

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\* Abstract of paper read at the Pittsburgh meeting.

conditions, either passive or active. It includes also the relations of these facts to one another, and the generalizations to be deduced, setting forth the unity of science.

Among the topics in which some progress has been made are:

Nature of matter in general.	<ul style="list-style-type: none"> <li>Theory of vortex atoms.</li> <li>Kinetic theory of gases.</li> <li>Deviations of actual from the ideal or "perfect" gas.</li> <li>Continuity of gaseous and liquid conditions, as in critical temperature and pressure.</li> <li>Kinetic theory of liquids, especially of solutions.</li> <li>Continuity of liquid and solid conditions, as in viscosity.</li> </ul>
Properties of the several chemical bodies.	<ul style="list-style-type: none"> <li>Periodic law of elements.</li> <li>Mutual attraction, as in capilarity.</li> <li>Freedom of motion, as in viscosity and diffusion.</li> <li>Volume, under varying conditions of temperature and pressure.</li> <li>Refraction, with correction for waves of infinite length.</li> <li>Polarization, in non-isotropic solids.</li> <li>Rotation of plane of polarization, traced to geometrical asymmetry.</li> <li>Simple and harmonic vibrations, as indicated by spectra.</li> <li>Melting and boiling points. Vapor tensions.</li> <li>Solubility.</li> <li>Electrical conductivity and electrolysis.</li> <li>Electro-motive force.</li> </ul>



It is true that in some samples of pure floral honey the percentage of ash approximates the percentage given, but in general it is very much less.

The three phenomena taken together, namely, right-handed polarization at ordinary temperatures, great deficiency in invert sugar, and high ash content appear to be, from the investigations so far made, analytical points by means of which a plant louse honey can be differentiated from a pure floral honey. It is understood, however, that the statement above made rests upon the analysis of six or eight samples of honey which, according to the reports received with the samples, were gathered largely from the exudations of the plant louse. An examination of a larger number of samples may show this dictum in regard to ash is not a reliable one, but the dicta respecting invert sugar and polarization are certainly correct. In other words, it appears possible, at the present time, to discriminate between a honey gathered by bees from exudations of plant lice and a pure floral honey extracted from the flowers themselves by the bees.

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Properties of the several chemical bodies.	<ul style="list-style-type: none"> <li>Periodic law of elements.</li> <li>Mutual attraction, as in capilarity.</li> <li>Freedom of motion, as in viscosity and diffusion.</li> <li>Volume, under varying conditions of temperature and pressure.</li> <li>Refraction, with correction for waves of infinite length.</li> <li>Polarization, in non-isotropic solids.</li> <li>Rotation of plane of polarization, traced to geometrical asymmetry.</li> <li>Simple and harmonic vibrations, as indicated by spectra.</li> <li>Melting and boiling points. Vapor tensions.</li> <li>Solubility.</li> <li>Electrical conductivity and electrolysis.</li> <li>Electro-motive force.</li> </ul>

Phenomena of chemical action.	{	Influence of mass.
		Speed of reactions.
		Manifestation of energy; as heat, light and electricity.
		Temperature required for limited or complete reaction.
		Conditions of equilibrium.

The foregoing scheme is tentative only; closely related matter being placed under different heads. Still it may help to direct attention to the broader and the subsidiary problems. Among the former are:

I. What is the real nature of matter in atoms and molecules, in elements and compounds, and in the several states of aggregation?

II. How far can the properties of each kind of matter be expressed as a function of the atoms (or other constituents) of which it consists?

III. What are the mechanical possibilities and limitations of chemical change?

If it were possible that physical chemistry should ever become a completed science, we should not only understand the nature of each kind of atom, but we should be able to predict the properties of any possible compound and the manifestations of energy with the conditions of equilibrium in any possible reaction.

Howard University, Washington, D. C.

## OFFICIAL MILK ANALYSIS IN CANADA.

BY PROF. W. H. ELLIS.

During the summer of 1887 the Public Analysts of Canada made a number of analyses of samples representing the mixed milk of herds of cows. The cows were milked in the presence of the Analyst and of an officer of the Inland Revenue Department, and duplicate samples taken by them, one of which was examined by the Public Analyst and the other sent to Ottawa and there analyzed by the Chief Analyst, Mr. Macfarlane.

Particular attention was paid to seeing that the cows were milked dry, and that the sample represented the whole milk of the herd. The milk from 167 herds was analyzed, which, if we assume the average number of cows in a herd to be six,\* will represent the milk of about a thousand cows.

The Chief Analyst's results were as follows :

	Average.
Solids .....	12.82
Fat .....	3.86
Solids not fat .....	8.96

The examination of the milk from the neighborhood of Toronto fell to my lot. I examined the milk of 37 herds, comprising more than 390 cows. The samples were analyzed by the method pre-

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\* This is below the truth. The instructions were that no herd of less than four cows was to be examined.

scribed by the Society of Public Analysts for Great Britain (*Analyst*, 1885, p. 46).

The total solids were dried on the water bath in flat bottomed platinum dishes to constant weight.

To determine the fat, milk was run into a stoppered weighing bottle, absorbed by a fat free paper coil, and the quantity of milk absorbed determined by the loss of weight. This coil was then dried in a water oven for one hour, exhausted in a Soxhlet apparatus with light petroleum, the petroleum evaporated and the fat weighed in a light flask after drying to constant weight in a water oven.

My analyses were published in a report to the Canadian government (supplement No. 111 to the report of the Department of Inland Revenue, 1888).

My results may be expressed as follows:

	Total Solids.	Fat.	Solids not fat.
Maximum.....	13.48	4.87	9.26
Mean.....	12.27	3.56	8.71
Minimum.....	10.77	2.70	8.00

The duplicate samples were analysed at Ottawa in the Chief Analyst's laboratory with the following results:

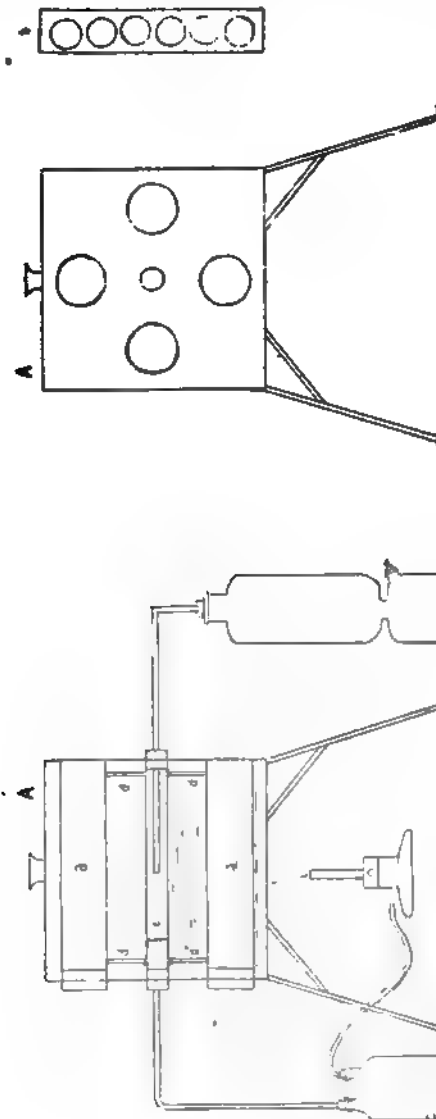
	Total Solids.	Fat.	Solids not fat.
Maximum.....	13.47	4.50	9.28
Mean.....	12.08	3.38	8.70
Minimum.....	10.68	2.52	8.17

The method employed at Ottawa is to weigh the milk into short funnel tubes packed with asbestos, dry in a water oven to get total solids, extract in a Soxhlet or other extraction apparatus large enough to hold several tubes, one above the other, with gasoline, weigh the solids not fat and estimate the fat by difference.

It will be seen that I obtained by the paper method about 0.2% more fat than was got by this asbestos process.

Thinking it desirable to study the effect of drying these finely

divided milk residues under different conditions I devised an oven of which the following is a description :



A is a copper box each side of which measures 9 inches. Four tubes a, a, a, a, run through it from front to back,  $2\frac{1}{4}$  inches diameter. In front they are open and fitted with corks. Behind they are closed. They serve to hold the asbestos drying tubes, which stand in holes in a strip of copper p, which can be pushed into the tubes a.

A fifth tube, c, runs through the centre of the box from front to back.

It is divided near the front by a partition and connected with each of the drying tubes a, by two connecting tubes d, d<sup>1</sup>, one in front of the partition and the other behind it and near the back. Both ends of the tube c are open and fitted with corks. The hinder cork carries a glass tube, which runs almost to the partition and is connected behind with a drying arrangement. The front cork carries a glass tube, which is connected with a Woulf's bottle.

To use the oven with hydrogen the gas is aspirated from a gas-holder through the drying apparatus into the tube c, where it becomes heated; thence it passes into the drying tubes a by the connecting tubes d; there it passes over the samples and back again into c, in front of the partition, by the connecting tubes d<sup>1</sup>; thence it passes to the Woulf's bottle, where it deposits most of its moisture and thence to a second gas holder.

With coal gas a drying apparatus is connected with the supply, and the Woulf's bottle is connected with a Bunsen burner beneath the oven, where the gas is burned, serving to boil the water in the oven.

Mr. W. Lawson, a student in my laboratory, has made the following determination with this apparatus:

Eighteen samples of the same milk were weighed out into asbestos tubes at the same time, and within the same hour six of them were put into an ordinary water oven, six into an oven filled with hydrogen, and six into an oven filled with coal gas.

The results were as follows:

<i>Total Solids.</i>					
	<i>In Air.</i>	<i>In Coal Gas.</i>		<i>In Hydrogen.</i>	
No. 1	12.212	No. 7	12.058	No. 13	11.979
2	12.235	8	12.078	14	11.997
3	12.256	9	12.072	15	11.949
4	12.222	10	12.005	16	11.959
5	12.251	11	12.019	17	11.998
6	12.239	12	12.031	18	12.049
<hr/>			<hr/>		
Mean	12.235	Mean	12.044	Mean	11.988

*Solids not Fat after Extraction with Gasoline.*

Air.		Coal Gas.		Hydrogen.	
No. 1	8.821	No. 7	8.521	No. 13	8.432
2	8.845	8	8.525	14	8.446
3	8.866	9	8.544	15	8.396
4	8.846	10	8.521	16	8.415
5	8.913	11	8.543	17	8.429
6	8.877	12	8.509	18	8.489
<hr/>		<hr/>		<hr/>	
Mean	8.861	Mean	8.527	Mean	8.434

*Fat (by Difference).*

Air.		Coal Gas.		Hydrogen.	
No. 1	3.391	No. 7	3.537	No. 13	3.547
2	3.390	8	3.553	14	3.551
3	3.390	9	3.528	15	3.553
4	3.376	10	3.484	16	3.544
5	3.338	11	3.476	17	3.569
6	3.362	12	3.522	18	3.560
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Mean	3.374	Mean	3.517	Mean	3.554

Five determinations of the fat were then made by the Werner-Schmidt method, with the following results:

	Fat per cent.
No. 1	3.543
2	3.560
3	3.618
4	3.539
5	3.595
<hr/>	
Mean	3.571

Comparing the averages of these fat determinations we get:

In air by asbestos	3.374 per cent.
In coal gas, by asbestos	3.517 “
In hydrogen, “	3.554 “
By Werner-Schmitt Method	3.571 “



The average percentage of fat in coal gas and hydrogen is .....	3.536
The average in air is .....	3.374
	<hr/>
A deficiency of .....	.162
The average total solids in air are .....	12.235
In hydrogen and coal gas .....	12.016
	<hr/>
An excess of .....	.219
The solids not fat in air are .....	8.861
In hydrogen and coal gas .....	8.480
	<hr/>
An excess of .....	.381

It appears, then, from these experiments that by long drying in the air at the temperature of the water oven, the milk solids undergo changes by which the total solids increase in weight 1.8% and the portion insoluble in gasoline increases in weight 4.3%, while the fat, as determined by difference, loses 4.5%, a part of it apparently becoming insoluble in gasoline.

The asbestos method as used by Mr. McFarlane is, in my judgment, the most simple and rapid gravimetric process at our disposal for the analysis of a number of samples at once. By drying in purified coal gas, in an apparatus such as I have described, it may be made without materially interfering with its simplicity, also, one of the most accurate.

## THE CONSTITUTION OF NICKELIFEROUS PYRRHOTITE.

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By Dr. S. H. EMMENS.

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It is the custom of mineralogists to speak of many mineral varieties as formed by one metal "replacing" another to a greater or less extent in certain chemical combinations. This is, I think I may say, the invariable account given in the text books respecting nickeliferous pyrrhotite, a mineral described as consisting of an iron sulphide in which "part of the iron is replaced by nickel." The object of the present paper is to enquire whether the account in question is a correct representation of the facts of the case, or whether the constitution of nickeliferous pyrrhotite differs from the description given in the text books.

The general formula of pyrrhotite is  $\text{Fe}_n \text{S}_{n+1}$ . This is sometimes written  $n (\text{Fe S})$ ,  $\text{Fe S}_2$  or  $n (\text{Fe S}) \cdot \text{Fe}_2\text{S}_3$ ; though probably, for reasons analogous to those recently set forth, (Journal of Analytical and Applied Chemistry, Vol. VI., No. 10, October, 1892), the more correct view is to regard the typical compound,  $\text{Fe}_3\text{S}_4$  as being a homogeneous body, and not as being composed of a mixture of sulphides. This question, however, is comparatively unimportant in the present discussion; as, whatever may be the precise arrangement of the molecules, their number will not be changed, and pyrrhotite will still be defined as an iron sulphide composed of  $n$  molecules of Fe and  $n+1$  molecules of S. And, on the "replacement" theory, nickeliferous pyrrhotite will be a sulphide composed of  $x$  molecules of Ni,  $n-x$  molecules of Fe and  $n+1$  molecules of S. Let us test this numerical theory by the actual results of analysis.

At p. 74 of the 6th edition of Dana's *Mineralogy* is a table of

analyses of various specimens of pyrrhotite. From this I will select the following for discussion, namely :

		S.	Fe.	Ni.
No. 14.	Brewster, N. Y. ....	37.98	61.84	0.25=100.07
" 15.	Putnam Co., N. Y. ..	39.28	60.03	0.78=100.09
" 15a.	" " ..	38.99	60.04	1.02=100.05
" 15b.	" " ..	39.85	58.73	1.53=100.11
" 20.	Frigido .....	39.65	58.18	2.17=100.
" 18.	Hilsen .....	40.27	56.57	3.16=100.
" 17,	Sudbury .....	38.91	56.39	4.66= 99.96
" 19.	Gap Mine, Pa. ....	38.59	55.82	5.59=100.

Now it is obvious that any replacement of iron by nickel must take place by whole molecules weighing respectively 58.6 for Ni and 55.9 for Fe. Hence for every Ni molecule in mineral No. 14

of the above list there must be  $\frac{58.6}{.25} \times \frac{61.84}{55.9} = 258.9$  molecules of

Fe; and, in like manner, there must also be  $\frac{58.6}{.25} \times \frac{37.98}{32} = 278.2$

molecules of S; or, in view of the analytical total being a little in excess of 100, we may regard the mineral as consisting of  $\text{Ni Fe}_{2.59} \text{S}_{2.78}$  instead of  $\text{Ni Fe}_{2.59} \text{S}_{2.61}$ , as called for by the pyrrhotite theory.

Similar calculations in the other cases give the following results :

No.	Ni	Fe	S	showing an excess of S		
No. 15	....	80.68	92.22			9.54
" 15a	....	61.71	70.00	"	"	6.29
" 15b	....	40.24	46.62	"	"	4.38
" 20	....	28.11	33.46	"	"	3.35
" 18	....	18.77	23.34	"	"	2.57
" 17	....	12.685	15.29	"	"	0.605
" 19	....	10.468	12.642	"	"	0.174

In none of these minerals does the formula  $(\text{Fe Ni})_n \text{S}_{n+1}$  hold good; and we therefore have reasonable ground for declaring that the constitution of nickeliferous pyrrhotite is *not* represented by this time-honored but somewhat superficial generalization.

It will be noticed that the excess of sulphur bears some relation to the percentage of nickel; the lower the nickel contents the greater being the surplus of sulphur, and *vice versa*. This necessarily follows from the great size of the compound molecule when the percentage of nickel is small. If, however, we investigate the proportion borne by the sulphur to the total metal, we shall find a tendency to constancy rather than to variation, as is shown in the following Table :

Per Centage of Nickel.	PROPORTION OF S MOLECULES IN EXCESS OF $n+1$ TO		
	Ni Molecules.	Fe Molecules.	Ni+Fe Molecules.
0.25	17.3	.0667	.0666
0.78	9.54	.1182	.1168
1.02	6.29	.1019	.1003
1.53	4.38	.1088	.1062
2.17	3.35	.1192	.1152
3.16	2.57	.1369	.1300
4.66	0.605	.0477	.04421
5.59	0.174	.0166	.01517

This suggests that the constitution of nickeliferous pyrrhotite is polymeric; an inference which is also supported by the fact that Nos. 17 and 19, containing the high nickel percentages of 4.66 and 5.59, show less than 1 complete molecule of sulphur in excess, and therefore require a multiplication of their several figures. Taken as a whole, however, the results of analysis are opposed to any assumption of homogeneity of structure.

Coming now to physical investigation, we are at once met by a feature that is conclusive against the hypotheses of "replacement" and homogeneity. I allude to the fact that nickeliferous pyrrhotite may be divided into two portions, one of which is magnetic while the other is non-magnetic. This fact has long been known to chemists. In 1879 Habermehl effected a separation of

the magnetic from the non-magnetic portions of pyrrhotite for the purpose of obtaining a pure mineral for analysis. In 1890 T. J. McTighe applied magnetic separation in the treatment of the nickeliferous pyrrhotite of Canada; and in July of this year T. A. Edison applied for a U. S. Patent, in respect of virtually the same invention, and filed a specification containing the following statement :

“ I have discovered that where magnetic pyrites, called “ pyrrhotite ” is nickeliferous, as it usually is to a more or less extent, the nickel is not distributed generally throughout the whole body of the pyrrhotite, but certain crystals are pure pyrrhotite or magnetic pyrites, while other crystals have some of the iron replaced by nickel and sometimes by cobalt, and that the crystals containing the nickel or cobalt are considerably less magnetic than the pure pyrrhotite.”

Any statement made by Mr. Edison is deserving of respectful attention ; but I believe that gentleman has frequently disclaimed anything beyond a rudimentary knowledge of chemistry and is therefore presumably open to correction in matters belonging to that department of science. Be this, however, as it may, I am safe in saying that pyrrhotite is rarely found in a crystalline form, and that crystals of nickeliferous pyrrhotite are as yet unrecorded as having been observed. Mr. Edison's mention of “ crystals ” is probably only a loose way of describing the minute fragments, particles or grains into which the massive pyrrhotite is divided by comminution.

Again, Mr. Edison speaks of the strongly magnetic particles as being “ pure pyrrhotite,” meaning thereby a non-nickeliferous iron sulphide of the general form  $\text{Fe}_n \text{S}_{n+1}$ . My own observations do not confirm the statement that nickeliferous pyrrhotite can be magnetically separated into nickeliferous and non-nickeliferous portions. A separation into two very distinct minerals or mineral mixtures is possible, and these contain very distinct percentages of nickel ; but both are nickeliferous. The following results obtained by Mr. C. T. Mixer at the laboratory of the Emmens Metal Company will illustrate this.

Two samples of nickeliferous pyrrhotite were taken, one from

the Gap mine, Lancaster Co., Pa., and the other from a mine near Sudbury, Ontario. These were very finely powdered and then each sample was carefully separated by means of a magnet into three grades, namely, "magnetic," "feebly magnetic" and "non-magnetic." The "magnetic" and "non-magnetic" grades were then analyzed and resulted as follows, after deduction of gangue :

	Ni.	Fe.	S.
Gap <i>magnetic</i> ----	0.35 ‰	59.97 ‰	39.68 ‰
“ <i>non-mag</i> ----	15.59 “	43.00 “	41.41 “
Sudbury <i>magnetic</i> ----	1.30 “	58.27 “	40.43 “
“ <i>non-mag.</i> ----	23.16 “	33.92 “	42.92 “

Treating these figures in the same way as those of the analyses recorded by Dana, we have :

1. MOLECULAR CONSTITUTION.

Gap mag-----	Ni	Fe	S	showing an excess of S
		46.99	56.95	7.96
“ non-mag----	Ni	Fe	S	“ a deficiency of S
		1.535	3.394	0.141
Sudbury mag----	Ni	Fe	S	“ an excess of S
		179.6	207.6	26
“ non-mag-	Ni	Fe	S	“ a deficiency of S
		2.891	4.864	0.027

2. PROPORTION OF EXCESS S TO METAL.

Percentage of Nickel.	Proportion of S molecules in excess of $n + 1$ to Ni molecules.	Fe molecules.	Ni + Fe molecules.
0.35	26.00	.1448	.1440
1.30	7.96	.1694	.1659
15.59	Slight deficiency of S.		
23.16	“	“	“

A comparison of the results here obtained with those from Dana shows conclusively that the magnetic minerals are of the pyrrhotite type, but that the non-magnetic concentrates are of a quite dissimilar constitution : and as the latter are much higher in nickel than the former it is also clear that the nickel is *not* present as an element replacing iron in pyrrhotite. It is also apparent that the minerals Nos. 17 and 19 of Dana are mixtures of the magnetic and non-magnetic minerals found in the Gap and Sudbury samples examined by Mr. Mixer.

Much additional investigation is needed to determine the true constitution of pyrrhotite and its allied nickel compound. It may be that experiments as to the solvent action of molten ferrous sulphide upon iron disulphide and nickel sulphide will throw the needed light upon the subject. Many geologists are of opinion that the massive pyrrhotites of Canada and other places are the cooled remains of a molten mass ; and every parcel of matter produced from a smelter is an object lesson respecting the varying mixtures that are possible under such conditions. Provisionally, therefore, we may regard the constitution of the minerals under discussion as represented by the following formulæ :

Crystalline pyrrhotite..  $n (\text{Fe}_3 \text{S}_4)$   
 Amorphous do ..  $n (\text{FeS}). x (\text{FeS}_2)$   
 Nickeliferous do ..  $n (\text{FeS}). x (\text{FeS}_2). y (\text{NiS})$

In conclusion it may be well to say a word as to the practical problem of the magnetic concentration of nickeliferous pyrrhotite. The two samples above referred to as examined by Mr. Mixer gave the following results :

1. Division of the total sample :

	Gap.	Sudbury.
Magnetic portion.....	58.66 per cent.	92.95 per cent.
Feebly magnetic portion..	6.67 “	2.09 “
Non- “ “ ..	34.67 “	4.96 “

2. Division of the total nickel contents :

	Gap.	Sudbury.
Magnetic portion.....	16.25 per cent.	58.01 per cent.
Feebly magnetic portion..	19.96 “	7.60 “
Non- “ “ ..	63.79 “	34.39 “

3. Total gangue in sample :

Gap .....	41.28 per cent.
Sudbury .....	10.7 “

4. Division of the total gangue :

	Gap.	Sudbury.
Magnetic portion.....	25.85 per cent.	75.51 per cent.
Feebly magnetic portion..	7.12 “	9.07 “
Non- “ “ ..	67.03 “	15.42 “

## 5. Percentages of gangue in the portions :

	Gap.	Sudbury.
Magnetic portion . . . . .	18.20 per cent.	8.70 per cent.
Feebly magnetic portion . .	44.00    “	46.60    “
Non-            “            “    . .	79.80    “	33.20    “

The practical inferences from these figures are as follows :

1. Magnetic separation will give a rich nickel concentrate.
2. An ore with considerable gangue will yield more of its nickel as “concentrate” than will be the case with cleaner ore.
3. The concentrate from clean ore will be of a higher grade than that from ore carrying much gangue.
4. The nickeliferous portion of the mineral is attached to the gangue more firmly than is the non-nickeliferous portion.
5. The nickel is *possibly an essential constituent of the gangue instead of being a constituent of the pyrrhotite.*

This last inference is so opposed to the generally received teachings that I have instituted a fresh series of investigations with a view to determine its correctness or the reverse. The results shall in due course be communicated to the Society ; and, in the meantime, all I can say is that at present they seem to favor the supposition of the gangue being nickeliferous.



## ON AMERICAN LITHOGRAPHIC STONES.

BY DR. C. W. VOLNEY.

I regret that, in preparing this report, I cannot give an exhaustive reference to existing literature on this subject; what I have been enabled to consult did not give me the desired information, and in order to obtain material for comparison I analyzed some mineral from Germany. This was of undoubtedly good quality. Lithographic limestone is the product of different geological formations. If it is true that any limestone of fine, even grain can be used in the lithographer's art, it is equally true that such material seems to be very difficult to find, although we have immense tracts of calcareous deposits to select from. Of the various samples of limestone which have been tested for lithographing purposes, many show in outward appearance a very close resemblance in grain and structure to varieties known to be good, but prove nevertheless worthless. To ascertain the real cause a physical examination seems insufficient, and on the other hand the chemical examination, so far as has come under my notice, does not show sufficient grounds for the established distinction. I quote here the analytical results given in the "Report of Mineral Resources of the United States, 1893," as follows:

### *Stone from Missouri.*

Silicates .....	31.2
CaCO <sub>3</sub> .....	817.7
MgCO <sub>3</sub> .....	151.0
Fe <sub>2</sub> O <sub>3</sub> .....	0.1
	<hr/>
	10000.

*Stone from Bavaria.*

Silicates .....	44.5
CaCO <sub>3</sub> .....	814.7
MgCO <sub>3</sub> .....	138.3
Fe <sub>2</sub> O <sub>3</sub> .....	2.5
	<hr/>
	1000.0

Nothing here would indicate any practical difference, and as it is reasonably sure that in physical properties, fineness of grain, etc., these stones resembled each other, a distinction for practical use could not be deduced from these analyses. To obtain, however, material for comparison, I procured German stones of undoubted good qualities as lithographic stone, and selected two, one of dark blue and one of light yellow color, with these results:

*Dark blue stone from Solenhofen:*

Spec. gravity at 15.5° = 2.952.

Insoluble silicate .....	2.0000
Organic matter .....	0.7200
CaCO <sub>3</sub> .....	90.9341
MgCO <sub>3</sub> .....	3.5710
Soluble silica .....	0.5200
Al <sub>2</sub> O <sub>3</sub> .....	0.5840
Fe <sub>2</sub> O <sub>3</sub> .....	0.2360
FeO .....	0.1300
Water .....	0.4000
	<hr/>
	99.951

*Light yellow stone from Solenhofen.*

Spec. gravity at 15.5° = 2.8388.

Insoluble silicate .....	1.8930
Organic matter .....	0.1320
Soluble silica .....	0.0200
CaCO <sub>3</sub> .....	99.5390
MgCO <sub>3</sub> .....	4.3801
Al <sub>2</sub> O <sub>3</sub> .....	0.1010
Fe <sub>2</sub> O <sub>3</sub> .....	0.3210
FeO .....	0.0030
Water .....	1.379
	<hr/>
	97.7681

*Light gray stone from Kentucky.*Spec. gravity at  $15.5^{\circ}=2.99331$ .

Insoluble silicate	11.500	
Organic matter	0.400	
CaCO <sub>3</sub>	73.241	
MgCO <sub>3</sub>	12.431	
Al <sub>2</sub> O <sub>3</sub>	}	1.141
Soluble silica		
Fe <sub>2</sub> O <sub>3</sub>		
Water	0.935	
	<hr/>	99.648

*Blue stone from Iowa.*Spec. gravity at  $15.5^{\circ}=2.8173$ .

Insoluble silicate	6.97500
Organic matter	3.30000
CaGC <sub>3</sub>	82.20051
Fe <sub>2</sub> O <sub>3</sub>	} 1.07631
Al <sub>2</sub> O <sub>3</sub>	
Soluble silica	
MgCO <sub>3</sub>	4.32703
Water	0.24001
	<hr/>
	98.11886

*Light gray stone from Missouri.*Spec. gravity at  $15.5^{\circ}=2.7558$ .

Insoluble silicate	4.300	
Organic matter	1.830	
CaCO <sub>3</sub>	77.031	
MgCO <sub>3</sub>	14.271	
Fe <sub>2</sub> O <sub>3</sub>	}	2.143
Al <sub>2</sub> O <sub>3</sub>		
SiO <sub>2</sub>		
Water	0.341	
	<hr/>	99.916

*Light blue gray stone from Canada.*

Spec. gravity at 15.5°=2.8388

Insoluble silicate .....	3.71200
Organic matter .....	0.40910
CaCO <sub>3</sub> .....	89.98900
MgCO <sub>3</sub> .....	2.78932
Al <sub>2</sub> O <sub>3</sub> and SiO <sub>2</sub> .....	0.73101
Fe <sub>2</sub> O <sub>3</sub> .....	0.15302
FeO .....	0.10431
Water .....	1.25000
	<hr/>
	99.13776

*Dark blue stone from Canada.*

Spec. gravity at 15.5°=2.89104

Insoluble silicate .....	3.6000
Organic matter .....	1.2900
CaCO <sub>3</sub> .....	88.0341
MgCO <sub>3</sub> .....	2.5000
Soluble silica .....	0.4900
Al <sub>2</sub> O <sub>3</sub> .....	0.5770
Fe <sub>2</sub> O <sub>3</sub> .....	0.3590
FeO .....	0.0410
Water .....	1.3601
	<hr/>
	99.2512

I observed that in a number of stones analyzed, in drying at 100°, a certain amount of organic matter volatilizes and escapes with the moisture contained in the stones. In most cases, therefore, the quantity of water will be found too high at the expense of organic matter. The latter contains nitrogen and traces of iodine, and is evidently the remnant of cretaceous fossils, and the silica may also originate from these fossils. It is certain that these organic remains cause the difference in the color, in fact they form the coloring matter of these limestones, and its presence does not seem to interfere, by any means, with the usefulness of the stone in lithographic art. It might be even presumed that the presence

of this partially destroyed animal matter may have had some influence on the peculiar precipitation, and, under great pressure, on the fine and even formation of these peculiar strata. The material collected by me and the work done so far does not justify a final conclusion ; but it is probably sufficiently strong to indicate it, and may give an idea for practical tests ; in all other respects, with the exception of some stones containing too much siliceous matter, the composition varies but little, and the differences are not pronounced enough to impair the quality of the stone for lithographic purposes.

Whatever the influence may have been of this organic matter on the precipitation of calcium carbonate—holding this and other inorganic substances in suspension, retarding quick precipitation and thereby assisting in the formation of even grained and dense strata under subsequent pressure, it may be conceded that lithographic stone was formed during or after the destruction of a large and peculiar fauna, like the jurassic and silurian limestone periods ; and if further analytical work should confirm what my present investigation seems to indicate, that this peculiar coloring matter is an essential feature of good lithographic stone, an identification of the proper material in the original deposits would thereby be greatly facilitated.

NEW YORK, December 17th, 1892.

## Abstracts of American Patents Relating to Chemistry.

(From the U. S. Patent Office Gazette.)

(Issued November 1, 1892.)

**485,177.**—Wall plaster. Charles L. Denison, Corning, N. Y.  
Composition consisting of lime, cottonseed meal, plaster of paris, borax and cream of tartar.

**485,185.**—Apparatus for carbureting air or gas. Edward J. Fust and Willis C. Squire, Philadelphia, Pa.

**485,199.**—Method of drying and burning brick. John C. Kinzel, Knoxville, Tenn.

**485,214.**—Adding machine. Charles A. Oakes, New York, N. Y.

**485,217.**—Refrigerating apparatus. Charles H. Parshall, Detroit, Mich.

**485,244.**—Method of and apparatus for charging soda water. John H. Vinton, Boston, Mass.

**485,246.**—Machine for disintegrating jute, etc. Philip H. Wait, Sandy Hill, N. Y.

**485,248.**—Treatment of sparkling wine. Armand Walfard, Rheims, France.

**485,257.**—Oil spraying device. Charles R. Collins, Philadelphia, Pa.

**485,272.**—Machine for opening and cleaning cotton. Wallace P. Groom, Brooklyn, N. Y.

**485,280.**—Amalgam for dentists' use. Gustav Jüterbock, Berlin, Germany.

A gold covered alloy prepared by rolling an alloy of silver and tin in thin sheets and pouring on the same a galvanic deposit of pure gold.

**485,288.**—Method of and apparatus for carbureting gas. Hiram S. Maxim, London, England.

**485,315.**—Vacuum evaporating apparatus. Homer T. Yaryan, Toledo, Ohio.

**485,319.**—Galvanic battery. Walter A. Crowds, Memphis, Tenn.

**485,321.**—Machine for securing incandescent bodies for gas burners in their holders. Otto B. Fahnenhjelm, Stockholm, Sweden, and Carl Dellwick, Rogers Park, Ill.

**485,322.**—Machine for manufacturing lamellæ or needles for incandescent gas burners. Otto B. Fahnenhjelm, Stockholm, Sweden, and Carl Dellwick, Rogers Park, Ill.

- 485,323.**—Brick machine. Thomas C. Fawcett, Leeds, England.
- 485,329.**—Process of making imitation long heron feathers. Simon Lewinsohn, Berlin, Germany.
- 485,340.**—Glass furnace. Richard M. Atwater, Pittsburg, Pa.
- 485,341.**—Process of and apparatus for purifying and maturing liquors or distilled spirits. Ira B. Cushing, Brookline, Mass.
- 485,343.**—Method of and apparatus for electro-depositing of metals. Charles R. Fletcher, Boston, Mass.
- 485,355.**—Apparatus for drying and germinating malt. Johann H. E. Rathmann, Buffalo, N. Y.
- 485,357.**—Oxidizing apparatus. Ethelbert A. Rusden, Providence, R. I.
- 485,362.**—Method of impregnating beer, etc., with carbonic acid gas and apparatus therefor. Otto Zwietusch, Milwaukee, Wis.
- 485,386.**—Machine for manufacturing and dispensing aerated water. John P. Jackson, Liverpool, England.
- 485,387.**—Apparatus for cleaning tin andterne plates. Thomas Jenkins, Llanelly, England.
- 485,388.**—Heating apparatus. Ernst P. H. Kelting, Oldeslohe, Germany.
- 485,390.**—Furnace for melting glass. John Kitson, St. Louis, Mo.
- 485,391.**—Gas producer. William A. Koneman, Chicago, Ill.
- 485,392.**—Method of and apparatus for recarbonizing metals. William A. Koneman, Chicago, Ill.
- 485,395.**—Anti-filling valve for bottles. Prentice B. Moore, North Wilbraham, Mass.
- 485,408.**—Manufacture of parchementized fiber tubes. Robert T. Frist, Wilmington, Del.
- 485,423.**—Alloy. Henry G. O'Neill, Louisville, Ky.  
An alloy having qualities of anti-fusion and great electrical resistance. Composed of copper, tin, silicon, nickel and zinc.
- 485,424.**—Electrical heater. Henry G. O'Neill, Louisville, Ky.
- 485,428.**—Concrete mixing machine. Ernest L. Ransome, Oakland, Cal.
- 485,437.** }  
**485,438.** } Water meters. John Thompson, Brooklyn, N. Y.  
**485,439.** }
- 485,453.**—Chemical reagent for use in the manufacture of alloys. Sherwood E. Cheeseman, Kansas City, Mo.  
Consists of "an alkaline liquid and an arsenite."
- 485,455.**—Slating compound. John B. Coles, Bayonne, N. J.  
Consists of "soluble glass, alumina water and pearlash."
- 485,461.**—Process of obtaining alumina and acetic acid. Frederick P. Dewey, Washington, D. C.
- 485,475.**—Centrifugal ore separator. Orrin B. Peck, Chicago, Ill.

- 485,488.**—Grain scourer. William A. Cockrell, Mount Perry, Ohio.  
**485,501.**—Ore feeder. Ernest A. Langford, Grass Valley, Cal.  
**485,517.**—Rock crushing machine. Giles W. Weller, Baker City, Ore.  
**485,525.**—Grain scourer. Herman A. Barnard, Moline, Ill.  
**485,526.**—Carburetor. Daniel Best, San Leandro, Cal.  
**485,534.**—Paper calendaring machine. Peter Dillon, Lawrence, Mass.  
**485,549.**—Brick press. Joseph J. Kulage, St. Louis, Mo.  
**485,551.**—Filter. Thomas T. Luscombe, Chicago, Ill.  
**485,570.**—Feed water heater for steam boilers. Charles C. Worthington, Irvington, N. Y.  
**485,574.**—Enamel for metal articles. Hubert Claus, Thale, Germany.  
**485,575.**—Paper making machine. Linus P. Clauson, Hamilton, Ohio.  
**485,578.**—Pressure regulator for compressed air machines. Ernest C. Fasoldt, Albany, N. Y.  
**485,594.**—Burner for burning gaseous fuel. Henry Adler, Allegheny, Pa.

*(Issued November 8, 1892.)*

- 485,606.**—Methods of producing stencils. William H. Bell, San Francisco, Cal. •

Ink impressions are arranged between an alum soaked sheet of paper and a gelatine plate; pressure is then applied, which causes the alum to penetrate the gelatine and harden that part of the gelatine not covered by the ink. After removal of the paper the plate is washed, whereby the gelatine beneath the ink is removed and the stencil produced. •

- 485,615.**—Manufacture of carbon filaments. Thomas A. Edison, Llewellyn Park, N. J.

Filaments of carbonizable material are suspended in a close chamber out of contact therewith, and, while kept straight by means of weights, the filaments are carbonized by application of suitable heat.

- 485,616.**—Incandescent lamp filament. Thomas A. Edison, Llewellyn Park, N. J.

- 485,617.**—Manufacture of carbon filaments. Thomas A. Edison, Llewellyn Park, N. J.

Prepared from suitable hydrocarbons after driving off the volatile constituents. Carbonized "asphaltine."

- 482,618.**—Apparatus for and process of refining copper by electricity. Franklin Farrer, Ansonia, Conn.

- 485,624.**—Current wheel. Henry C. Gardner, Nashville, Tenn.

- 485,634.**—Apparatus for extracting sulphur. Léon Labois, Paris, France.

- 485,636.**—Clay drying and sifting apparatus. Ezekiel C. Little, St. Louis, Mo.



**485,660.**—Process of and apparatus for washing and drying phosphate rocks. Rufus S. Rose, Kissimmee, Fla.

**485,665.**—Process of and apparatus for aerating liquids. Carl H. Schultz, New York, N. Y.

**485,688.**—Composition of matter for journal bearings. Abraham G. Haley, Gardner, Me.

A composition consisting of "graphite, metallic pigment, fiber and a cementing of binding substance."

**485,691.**—Method of and apparatus for lining pipes with lead. George W. Harrington, Wakefield, Mass.

**485,695.**—Apparatus for washing fabrics. Joseph Hanorth, Church, England.

**485,714.**—Apparatus for raising and forcing water or other liquids. Isaac Shone and Edwin Ault, London, England.

**485,730.**—Process of treating oxidized or corroded lead. Richard W. F. Abbé, Brooklyn, N. Y.

**485,734.**—Machine for testing flax or other fibre-yielding plants. Eugene Borse, St. Paul Park, Minn.

**485,759.**—Intermittent siphon. Rogers Field, London, Eng.

**485,762.**—Furnace. John H. Johnson and James Moran, Orange, Tex.

**485,784.** Processes for casting armor. George H. Chase and Henry L.

**485,785.** Gantt, Philadelphia, Pa.

**485,788.**—Filtering tube. Moritz Epstein, Berlin, Germany.

**485,796.**—Apparatus for superheating vapors and gases. Moritz Honigmann, Grevenberg, Germany.

**485,797.**—Screen for metallic fumes. Malvern W. Iles, Denver, Col.

**485,805.**—Ice forming and preserving room. James M. Rosse, Nyack, N. Y.

**485,808.**—Paper pulp digester. Charles Curtis, Newton, Mass., and Nathaniel M. Jones, Bangor, Me.

**485,809.** } Ditto.

**485,810.** }

**485,820.**—Means for burning solid carbonaceous fuels. William McClave, Scranton, Pa.

**485,822.**—Dough kneader. Edwin Prescott, Arlington, Mass.

**485,826.**—Voltmeter. Eugene R. Carichoff, Richmond, Ky.

**485,827.**—Lighting and heating apparatus. Daniel W. Clegg, Stapleton, N. Y.

**485,837.**—Apparatus for pressing and disintegrating fibrous material. John H. Brown, New York, N. Y.

**485,840.**—Method of bricking fine iron ores. Thomas A. Edison, Llewellyn Park, N. J.

**485,841.**—Method of magnetically separating ores. Thomas A. Edison, Llewellyn Park, N. J.

Process of separating magnetic oxide of iron from magnetic pyrites where both occur in the same ore, by subjecting the crushed ore to a magnetic current of such strength that the oxide of iron particles only will be acted upon.

**485,842.**—Method of magnetic ore separation. Thomas A. Edison, Llewellyn Park, N. J.

For separating nickeliferous from non-nickeliferous pyrrhotite by process similar to the above.

**485,864.**—Ore pulverizer. Ryerson D. Gates, Ridgeland, Del.

**485,877.**—Apparatus for making gas. Alonzo Noteman, Toledo, Ohio.

**485,903.**—Fiber preparing machine. John L. Acosta, Vera Cruz, Mex.

**485,904.**—Method of manufacturing or burning coke. James A. Anderson, Highland Park, Ill.

**485,906.**—Process of and machine for soldering. Charles M. Brown, Chicago, Ill.

**485,907.**—Process of and machine for soldering. Charles M. Brown, Chicago, Ill.

**485,910.**—Gas burner. Cyrus S. Dean, Fort Erie, Canada.

**485,911.**—Drier. Ellsworth De Lany, Syracuse, and James Dooley, Camillus, N. Y.

**485,915.**—Method of separating grain and dust or stive from air laden therewith. Frederick E. Duckham, London, England.

**485,917.**—Process of treating clay and products thereof. Alexander D. Elbers, Hoboken, N. J.

**485,919.**—Manufacture of mandrils for electrolytic deposit of tubes. Francis E. Elmore, Leeds, England.

**485,921.**—Paper carpet. Morris G. Faulkner, Homer, N. Y.

A composition for treating vehicle floor coverings, consisting of "water, glue, alum, starch, asphaltum lead and whiting," mixed and suitably colored.

**485,927.**—Process of melting iron. Henry J. Graf, St. Louis, Mo.

**485,940.**—Apparatus for bleaching fruit. Elias Ireland, Winters, Cal.

**485,942.**—Bottle filling apparatus. John Jackson, Lonsdale, R. I.

**485,953.**—Siphonic water distributing apparatus. John K. Leedy, Tom's Brook, Va.

**485,962.**—Ore separator. Carl A. E. Meinick, Clausthal, Germany.

**485,966.**—Furnace. George T. Moe, Philadelphia, Pa.

**485,972.**—Ore concentrator. Thomas T. McNary, Hailey, Idaho.

**485,986.**—Malting apparatus. Jules Saladin, Nancy, France.

**485,992.**—Measuring vessel. John Snorf, Fairland, Mich.

**485,999.**—Process of and apparatus for ageing liquors. Theodore R. Timby, Washington, D. C.

The process consists in "subjecting the liquors in bulk to rapid mechanical vibration, producing a continuous tremulous action throughout the body of the liquor."

**486,000.**—Apparatus for ageing wines, spirits or other liquors. Theodore R. Timby, Washington, D. C.

**486,015.**—Crystallizing and setting box. Freeling W. Arvine, Port Richmond, N. Y.

**486,026.**—Hydrocarbon oil vaporizer and burner. George Botsford, New Haven, Conn.

*(Issued November 15, 1892.)*

**486,070.**—Calculating instrument. George M. Andrews, Boston, Mass.

**486,094.**—Secondary battery. Rudolf Eickenmeyer, Yonkers, N. Y.

**486,095.**—Fluid motor. Charles F. Elmes, Chicago, Ill.

**486,098.**—Steam generator. Thomas Fearon, Yonkers, N. Y.

**486,100.**—Manufacture of coke. James J. Fronteiser and Charles S. Price, Johnstown, Pa.

**486,110.**—Blast furnace. Julian Kennedy, Pittsburg, Pa.

**486,123.**—Electric meter. John Perry, London, England.

**486,127.**—Apparatus for making lampblack. Swain Salbug, Ridgway, Pa.

**486,130.**—Digesting apparatus. Alex. Selkirk, Albany, N. Y.

**486,133.**—Boiler tube cleaner. William B. Smith and James R. Smith, Birmingham, Ala.

**486,134.**—Hot air furnace. James E. Spencer and Joseph L. Spencer, Des Moines, Iowa.

**486,150.**—Apparatus for cooling and washing gas. Charles H. Wilder, Boston, Mass.

**486,165.**—Composition of matter for producing Portland cement. Herry J. Livingston, New Orleans, La.

Consists of shell containing 90% and upward of lime, alluvial clay, and ground chalk flints.

**486,167.**—Smoke consuming steam boiler furnace. Frank Reynolds, Omaha, Neb.

**486,172.**—Method of disinfecting sewage. Hugo Wollheim, London, England.

The sewage is treated with a prepared mixture of milk of lime and trimethylamine.

**486,188.**—Bleaching compound. Hamilton Y. Castner, London, England.

Composed of sodium peroxide and one or more neutral salts of the alkaline earth metals.

**486,196.**—Lubricant. Charles H. Ridsdale, Guisborough, and Alfred Jones, Middleborough, England.

Consists of a "combination of an alkaline earth and fatty matter, consisting largely of stearine, ordinary soap, and sulphur."

**486,224.**—Carburetor. Nicholas Finck, Elizabeth, N. J.

**486,225.**—Apparatus for impregnating liquids with carbonic acid. Charles H. Frings, New York, N. Y.

**486,232.**—Ore concentrator. Pedro de Napoles, San Francisco, Cal.

**486,246.**—Percolator. John W. Evans, Cleveland, Ohio.

**486,247.**—Smoke purifier. Conrad Fink, St. Louis, Mo.

**486,264.**—Electric battery. John J. O'Lalor, Boston, Mass.

**486,267.**—Soap compound. Jonathan Sharr, Philadelphia, Pa.

Consists of "soap bark, water, crude turpentine, soda, sal-ammoniac, borax, camphor, oil and caustic soda." Used for treating wool for carding and spinning.

**486,329.**—Plaster compound. Henry R. English, Jackson, Mo.

Consists of "kaolin, silicate of soda, glue and sand."

**486,330.**—Process of treating speiss. Paul Flury, El Paso, Tex.

**486,339.**—Process of treating fibrous material for making pulp. James Johnston, Peter Culter and George Johnston, Denny, Scotland.

**486,356.**—Artificial block for pavements. David P. Sanders, Williamsport, Pa.

**486,363.**—Chinolinchinophenol sulphate and method of obtaining same. Joseph Ziegler, Bubrich, Germany.

A sulphur-yellow powder possessing a slight odor of chinolin, very readily soluble in water, forming a thick mass at 96° C., fusible at 114° C., and produced from orthoxychinolin by heating a mixture of one of said substances and a sulphate of the other.

**486,390.**—Centrifugal cream tester. Peter V. P. Berg, Askor-Vejen Station, Denmark.

**486,406.**—Process of removing sulphurous compounds from oils. John B. Huston, Cleveland, Ohio.

**486,411.**—Method of increasing the efficiency of motor fluids. William L. Saunders, Plainfield, N. J.

**486,413.**—Water filter. Henry A. Siegrist and George M. Bithman, St. Louis, Mo.

*(Issued November 22, 1892.)*

**486,442.**—Carburetor. John A. Enos, Boston, Mass.

**486,443 to 486,450.**—Manufacture of artificial stone or cement. Plastic cements, of which magnesium oxide and magnesium chloride are the chief feature.

**486,484.**—Keg or barrel tilter. Walter I. Leggett, Galesburg, Ill.

**486,485.**—Pressure regulator. Joseph Lehe and Joseph Bodam, Rochester, N. Y.

**486,491.**—Gas producer. Alexander K. Murray, Bedford, Pa.

**486,495.**—Method of and apparatus for separating graphite or like substances from crushed rock. Axel W. Nibelius, Hackettstown, N. J.

**486,496.**—Process of turning iron and steel plates. Edwin Norton, Maywood, Ill.

**486,512.**—Incinerating furnace. Oscar Stevens, Clear Lake, Iowa.

**486,535.**—Construction of tanks, reservoirs, silos, etc. Pierre A. J. Monier, Plaine St. Denis, France.

**486,540.**—Gas furnace. Frederick Siemens, Dresden, Germany.

**486,548.**—Soda water apparatus. Jonathan Ramsey and Roswell Carleton, Boston, Mass.

**486,550.**—Odor removing device for cooking stoves. Charles T. Toliver and Powhattan Ruffin, Boston, Mass.

**486,554.**—Condenser. Henry S. Blackmore, Mount Vernon, N. Y.

**486,557.**—Brick kiln. Charles B. Coxe, Brooklyn, N. Y.

**486,575.**—Process of electrically reducing refractory compounds. Thomas L. Wilson, Leaksville, N. C.

The pulverized metallic compound is impregnated with a reducing agent (tar) by saturating it therewith while the latter is in a liquid condition, drying to expel volatile constituents, and then subjecting the tar impregnated compound to the smelting action of an electric current.

**486,582.**—Smoke consuming device. Emil Kunzer, Chicago, Ill.

**486,590.**—Process of producing inlaid work on stones. Rudolf Rausch, Vienna, Austria-Hungary.

**486,594.**—Method of treating minerals, mattes, speiss or other substances containing nickel. Jean De Coppet, Paris, France.

**486,595.**—Method of treating minerals, mattes, speiss or other substances containing nickel. Jean De Coppet, Paris, France.

**486,607.**—Method of and means for making patterns for individual lasts. George W. Willey, Brockton, Mass.

**486,613.**—Process of refining gold and silver matter. Werner Langguth, Deadwood, S. D.

**486,622.**—Concentrator. James Tulloch, Angels, Cal.

**486,629.**—Means for coloring paper. William N. Cornell, Brownsville, N. Y.

**486,635.**—Apparatus for manufacturing tin plate. Daniel Edwards, Morristown, England.

**486,638.**—Machine for surface coating paper. Chas. M. Gage, Pepperell, Mass.

**486,647.**—Process of obtaining ammonia or other salts from molasses. Lothar Sternberg, Jersey City, N. J.

**486,689.**—Electrical measuring instrument. Edward Weston, Newark, N. J.

**486,690.** ) Apparatus for storing, handling and transporting liquids.

**486,691.** ) August Cirkel, Boyd, Wis.

**486,698.**—Process of and apparatus for treating ores of gold. Louis C. Daumas, Paris, France.

**486,706.**—Artificial Portland cement. Carl von Forell, Brunswick, Germany.

**486,714.**—Apparatus for casting pig iron. Henry I. Hibbard, Pittsburg, Pa.

**486,727.**—Thermostatic regulator. Edwin C. Merrill, Allegheny, Pa.

**486,744.**—Process of saturating articles or substances. John A. Titzel, Glenshaw, Pa.

**486,760.**—Oil can and siphon pump. Theodore Bumann, Bunker Hill, Ill.

**486,761.**—Method of burning clay to make ballast. Henry G. and William Butler, Kenosha, Wis.

**486,770.**—Process of making salicylate of phenyl. Paul Ernest, Ludwigshafen, Germany.

**486,781.**—Smoke consumer. Julius L. Hornig, St. Louis, Mo.

**486,806.**—Drier. Birney C. Batcheller, New York, N. Y.

*(Issued November 29, 1892.)*

**486,854.**—Boiler furnace and smoke consumer. James Connelly, Des Moines, Iowa.

**486,859.**—Water filter. Joseph Davis, San Francisco, Cal.

**486,860.**—Water filter. Joseph Davis, San Francisco, Cal.

**486,870.**—Composition for wall coverings. La Roy F. Griffin, North Granville, N. Y.

**486,873.**—Colors for printing on textile fabrics. Adolf Hoz, Linden, Germany.

**486,876.**—Centrifugal extractor. William E. Johnson, New York, N. Y.

**486,879.**—Magnetic separator. Thomas J. Lovett, Chicago, Ill.

**486,927.**—Washer or scrubber for gas. Josiah C. Chandler, London, England.

**486,937.**—Pulverizer or mixer. Robert W. Lyle, New York, N. Y.

**486,941.**—Process of reducing ores. Auguste J. Rossi, New York, N. Y.

“Process of fluxing titaniferous iron ore, which consists in combining their titanic acid with bases and fixed alkalies as fluxes, so as to form in the slag predominant titanates of those bases and subjecting the combination to the usual heat and treatment of a blast furnace.”

**486,966.**—Fire kindler. Sigmund Elsinger, Savannah, Ga.

**486,972.**—Continuous brick piler. Carl H. Kaul, Madison, Neb.

**486,983.**—Process of utilizing heat in the manufacture of sugar and salt. Samuel M. Lillie, Philadelphia, Pa.

**486,991.**—Safety gas burner. Bayard E. Taylor, Chicago, Ill.

**486,992.** Disk water meter. James A. Tilden, Hyde Park, Mass.

**486,998.**—Fluid fuel feeder. Ezra T. Williams, Chicago, Ill.

**487,013.**—Method of securing designs on glass articles. Albert A. Grasser, Pittsburg, Pa.

The design or photograph is transferred with vitrifiable colors to the lower surface of the glass article, a suitable opaque enamel applied to cover the design, and the whole burned at a suitable heat.

**487,027.**—Still. Julius C. Dittrich and Frederick M. Grumbacher, New York, N. Y.

**487,046.**—Electric light carbon. James Glegg, London, England.

Metallic matter is deposited upon the carbon filaments by electrically heating the filaments to incandescence "while they are suspended in a vessel from which all air or oxidizing vapor is excluded above a volatile liquid, such as alcohol, having dissolved or suspended in it a haloid or acid salt or an oxide of some one or more suitable metals."

**487,055.**—Centrifugal butter extractor. Olaf Ohlson, Newark, N. J.

**487,067.**—Membranoid. James W. Deckert, Newark, N. J.

**487,073.** } Magnetic separators. Thomas J. Lovett, Chicago, Ill.

**487,074.** }

**487,080.**—Explosive powder. Jean V. Skoglund, Stockholm, Sweden.

"Dried grains of nitrated cellulose, gelatinized by means of a solvent containing a fat or fatty acid."

**487,088.**—Liquid ejecting device for bottles, etc. Franklin S. Cooley, Philadelphia, Pa.

**487,089.**—Process of treating liquids with ozone. Julius C. Dittrich and Frederick M. Grumbacher, New York, N. Y.

**487,091.**—Package for bleaching and packing rosin. David W. Ketcham, Evanston, Ill.

**487,100.**—Process of and device for reducing volatilized metals. Charles E. Seymour, Hurley, Wis.

**487,119.**—Refining Canadian or similar petroleum oils. Herman Fischer, London, Canada.

**487,121.**—Lithographic plate. Franklin F. Haggemuller, New York, N. Y.

**487,147.**—Lamp for burning hydrocarbon or other oils. Samuel A. Johnson, London, England.

**487,156.**—Brick kiln. Louis H. Reppell, Kansas City, Mo.

**487,167.**—Eugenol benzyl-ether and process for preparing same. Fritz Ach, Mannheim, Germany.

The process consists in "dissolving eugenol in rectified spirits, adding thereto alkaline hydrates and a halogen compound of benzyl, heating the mixture, and then distilling off the spirits and adding water to precipitate eugenol benzyl-ether and finally purifying the eugenol benzyl-ether." A colorless oil solidifying in thick prisms which melt at 29 to 30 per cent.

**487,173.**—Fumigator. Robert Campbell, Lostock, near Northwich, England.

**487,174.**—Brick kiln. Joseph Conley and James M. Wolfe, Tarkis, Mo.

**487,176.**—Process of electro-depositing alloys. Sherard O. Cowper-Coles, London, England.

An alloy of silver and any known metal or metals other than the rare metals having a specific gravity between 6.5 and 9.0 at 15° C., and boiling between 710° and 1045° C., is deposited electrolytically on metals or other suitable articles by placing the latter "in a bath of the double cyanides of such metal or metals and silver and potassium, and an anode is employed consisting of an alloy of the metals to be deposited in approximately the proportions of the deposit."

**487,188.**—Process of extracting metals from refractory ores. Henry R. Lewis, London, and Charles B. Phillips, Chester, England.

**487,195.**—Steam generator. Thomas McBride, Philadelphia, Pa., and Ebenezer Fisher, Kincardine, Canada.

**487,203.**—Anti-friction lubricating compound. John B. Wallace and John W. Stevens, Gallion, Ohio.

**487,204.**—Process of preparing vanillin. Fritz Ach, Mannheim, Germany.

By "dissolving eugenol in alcohol, adding thereto alkaline hydrate and a halogen compound of benzyl, and heating the mixture. Second, dissolving the resulting eugenol benzylether in alcohol, adding thereto alkaline hydrate, keeping the same at the boiling point for some time, then partially distilling off the alcohol and adding water to the residue. Third, adding to the resulting isoeugenol benzyl ether a mixture of sodium chromate, sulphuric acid and water, and, finally, adding hydrochloric acid to the resulting vanillin benzyl ether."

It crystallizes in fine needles or transparent plates which melt at 63° to 64° C.

**487,205.**—Isoeugenol benzyl ether and process of preparing the same. Fritz Ach, Mannheim, Germany.

Eugenol benzyl ether is dissolved in alcohol, alkali hydrate added thereto, the mixture kept at the boiling point for some time, after which the alcohol is partly distilled off, water added to the residue and the resulting isoeugenol benzyl ether (a yellowish brown crystalline mass) purified by pressing and recrystallizing from alcohol. It crystallizes in felted needles and having a melting point of 58 to 59° C.

**487,216.**—Purifying petroleum. Herman Frasch, Cleveland, Ohio.

*(Issued December 6, 1892.)*

**487,244.**—Embalming apparatus. Herbert J. Breeze, Olean, N. Y.

**487,248.**—Ore separator and concentrator. George Carson, Council Bluffs, Iowa.



- 487,261.—Ore concentrating machine. Andrew Frazer, San Francisco Cal.
- 487,285.—Electrical heater. Willis Mitchell, Malden, Mass.
- 487,286.—Glass tank furnace. William F. Modes, Streator, Ill.
- 487,300.—Steam generator. Wright D. Smith, Detroit, Mich.
- 487,310.—Method of heating by metal bath. Frederick L. White, Milwaukee, Wis.
- 487,316.—Centrifugal butter extractor. Gustav M. Andersson, Newark, N. J.
- 487,317.—Means for superheating steam. Alexander Beatobuloff, Bielaia Turkov, Russia.
- 487,323.—Apparatus for separating molasses from sugar. Emmett A. Ellis, Sartartia, Tex.
- 487,324.—Galvanic battery. James L. Gethino, Boston, Mass.
- 487,338.—Method of mixing alloys. William R. Thomas, Catasauqua, Pa.
- 487,339.—Ice shaving machine. George B. Webb, Kinston, N. C.
- 487,342.—Process of carbonating fermented beverages. Jacob F. Wittermann, Yonkers, N. Y.
- 487,349.—Machine for plucking hairs from skins. Frank J. Murphy, Danbury, Conn.
- 487,370.—Ice cream freezer. Henry Mayers, San Francisco, Cal.
- 487,384.—Automatic faucet. Aaron A. Belleau, Brooklyn, N. Y.
- 487,390.—Ozone tube. Oscar Frohlist, Berlin, Germany.
- 487,405.—Beer cooler. John F. Duffy, Brooklyn, N. Y.
- 487,421.—Oil filter. Oscar Lindberg, Helsinborg, Sweden.
- 487,425.—Method of preparing glass metal. Roger S. Pease, Rose, Minn.
- 487,426.—Apparatus for moulding glass metal, etc. Roger S. Pease, Rose, Minn.
- 487,431.—Bakers' oven. George R. Skillmann, Baltimore, Md.
- 487,439.—Process of manufacturing sugar. Edward C. Bartheleny, New Orleans, La.
- 487,444.—Process of smelting ores containing zinc. Henry A. Hunicke, St. Louis, Mo.
- 487,467.—Filtering system. Robert Beyrle, Los Angeles, Cal.
- 487,478.—Mercurial air pump. Gustav A. Frei, Springfield, Mass.
- 487,507.—Apparatus for mixing flour or other materials. John D. Bangert, Baltimore, Md.
- 487,511.—Ore rake. John C. Blau, Wilmington, Del.
- 487,519.—Thermostat. Franklin O. Elliott, Catawaba, N. C.
- 487,521.—Automatic damper for furnaces, etc. David W. Glendenning, Denver, Col.
- 487,523.—Ore concentrator. Alfred Gonzalez, San Francisco, Cal.

**487,531.**—Barrel filler. Karl Kiefer, Cincinnati, Ohio.

**487,542.**—Device for operating ore concentrators and allied machines. Charles E. Seymour, Lake Geneva, Wis.

**487,549.**—Feed water heater. William J. Austin, Fond du Lac, Wis.

**487,579.**—Process of treating gold and silver ores. George W. McGee, Chicago, Ill.

The crushed ore is submerged in a solution of caustic soda or potash, after which salts of oxalic acid are added and the liquid evaporated.

**487,588.**—Disinfecting apparatus. Emil Taussig and Salomon Taussig, New York, N. Y.

**487,605.**—Combined furnace for treating and reducing ores and for refining the resulting metals. Antoine Chabaud, L. Leopold Van Heers and Louis A. Allard, St. Louis, Mo.

**487,606.**—Coating surfaces with plastic material. Melvin B. Church, Grand Rapids, Mich.

**487,607.**—Method of arc and incandescent metal heating. Charles L. Coffin, Detroit, Mich.

**487,614.**—Filter. Warren R. Evans, Portland, Me.

**487,616.**—Apparatus for manufacturing gas. James Gray, Lima, Ohio.

**487,617.**—Process of carbureting air. Arthur B. Griffen, Newark, and William C. Clarke, Bloomfield, N. J.

**487,638.**—Baking oven. Paul Pfeiderer, London, England, and Herrmann Werner, Cannstatt, Germany.

**487,639.**—Process of elevating liquids. Julius G. Pohlé, Jersey City, N. J.

**487,644.**—Process of and apparatus for generating electricity. J. S. Rogers, New York, N. Y.

The process consists in "exposing a fusible electrolyte capable of being deoxidized and reoxidized while in a state of fusion in the presence of suitable electrodes to a current of a deoxidizing gas injected in one direction and to a current of an oxidizing gas injected in the opposite direction."

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**487,713.**—Thermostatic vessel. Henry Carmichael, Malden, Mass.

**487,724.**—Feed water heater and purifier. Jules J. J. DeRycke, Brooklyn, N. Y.

**487,729.**—Caustic soda distributor. William S. Fickett, Rochester, N. Y.

**487,763.**—Cleaning tin plate or metallic sheets. Edwin Norton, Maywood, Ill.

**487,782.**—Process of disintegrating vegetable substances. Alexander Selkirk, Albany, N. Y.

- 487,783. } Digesting apparatus. Alex. Selkirk, Albany, N. Y.  
487,784. }
- 487,790.—Beer filling apparatus. Heinrich Stockheim, Mannheim, Germany.
- 487,792.—Steam generator. Thomas L. Sturtevant and Thomas J. Sturtevant, Framingham, Mass.
- 487,803.—Apparatus for rolling plate glass. Edward Walsh, Jr., St. Louis, Mo.
- 487,817.—Means for regulating the flow of liquids from vessels. Frederick E. Baldwin, New York, N. Y.
- 487,823.—Smoke consuming furnace. George L. Cross, Springfield, Mass.
- 487,827.—Process of drying brick. Charles J. Dion, St. Paul, Minn.
- 487,834.—Manufacture of secondary battery electrodes. William W. Griscom, Haverford, Pa.
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- 487,908.—Gas meter register. Henry A. Tobey, Toledo, Ohio.
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- 487,913.—Fibre-disintegrating machine. John B. Carter and Jesse H. Berst, Kokomo, Ind.
- 487,928.—Production of adhesives. Ludwig Kerr, Hamburg, Germany.
- 487,943.—Centrifugal liquid separator. Henry F. Beimling, Philadelphia, Pa.
- 487,971.—Apparatus for condensing fumes. Albert F. Schneider, St. Louis, Mo.
- 487,979.—Disinfecting device. John W. Bowerbank, Jersey City, N. J.
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The "process of making ammonia and tar which consists in drying and calcining nitrogenous material—such as peat—to drive off separately the aqueous and tarry vapor, passing the tarry vapors through incandescent material, thereby forming tar ammonia and combustible gas, the said incandescent material being heated by the said combustible gas; and simultaneously treating the calcined material with heated air and the said aqueous vapor to form ammonia and heating gases, the said heating gases being utilized for heating the said air and calcining the said nitrogenous material."

- 488,208.—Apparatus for generating gas. Oscar Langberg, Brooklyn, N. Y.  
 488,211.—Coal separator. Eugene F. Long, Scranton, Pa.  
 488,216.—Apparatus for dyeing. Rudolph Nicklis, Lorraine, France.  
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**488,290.**—Process of making oxyuvitic acid. Bruno R. Seifert, Radebad, Germany.

**488,817.**—Filtering material. Ferdinand Lascar, New York, N. Y.  
Consists of jute impregnated with tannate of iron.

**488,888.**—Process of embalming. Taylor Martin, Fairmont, W. Va.

**488,848.**—Brick or tile cutter. A. Z. Williams, Chicago, Ill.

**488,855.**—Oil burner. Alfred E. Harper, Chicago, Ill.

**488,874.**—Process of making white lead. Elwyn Waller and Charles A. Sniffin, New York, N. Y.

The process "consists in subjecting a solution of basic lead acetate with water impregnated with carbon dioxide, while said mixture is in mass and under a pressure above the atmospheric pressure, to the action of carbon dioxide gas, and agitating the mixture during the admixture of the gas therewith, said pressure being maintained during precipitation of lead from the solution in the form of lead hydrocarbonate."

**488,899.**—Wood pulp drainer. George M. Newhall and Charles L. Hamilton, Philadelphia, Pa.

**488,408.**—Machine for cleaning malt. Ernst Richter, New York, N. Y.

**488,418.**—Pottery kiln. Werner H. Zimmer and Otto G. Hess, Wheeling, W. Va.

**488,414.**—Apparatus for heating tar. Joseph H. G. Zunner, Boston, Mass.

**488,416.**—Composition for removing paint or varnish from wood. George L. Ball, Allegheny, Pa.

A mixture of benzole, fusel oil and alcohol.

**488,430.**—Basic yellow dye. Jacob Gnehm and Jakob Schrind, Basle, Switzerland.

Dyestuff obtained from dimethyldiamidodiorthotolylmethane. A yellow powder, readily soluble in water and in alcohol, insoluble in benzine, and yielding a violet red solution when treated with acetic acid, zinc dust and hydrochloric acid.

**488,438.**—Compound for tempering steel. Hiland E. Hopkins, Barton, Vt.

"A liquid composition for tempering metals, consisting of twenty grains of potassium bromide to one gallon of crude lubricating oil and double the quantity of soft water."

**488,470.**—Process of reducing franklinite ores. George G. Corners, Salisbury, Pa.

Process of "treating ores containing franklinite, willemite and zincite, which consists in treating the franklinite to render it magnetic, separating it by magnets from the willemite and zincite, reducing the willemite and zincite to spelter by a Belgian or other suitable furnace, treating the franklinite in the Wetherill or other suitable furnace for the manufacture of oxide of zinc and smelting the residuum from the franklinite for spiegeleisen."

**488,471**.—Process of treating franklinite and willemite. George G. Corners, Salisbury, Pa.

Similar to the above.

**488,479**.—Anti-fouling paint. Anson L. Munson, East Oakland, Cal.

An anti-fouling paint containing a pigment, mercurous chloride, and a vehicle consisting of coal tar, chloride of zinc and oil of turpentine.

**488,517**.—Apparatus for moulding pulp. Stanley L. Chapman, Evanston, Ill.

**488,519**.—Self purifying superheating steam generator. Benjamin F. Field, Chicago, Ill.

**488,524**.—Feed water heater and purifier. James MacDonald, Los Angeles, Cal.

**488,527**.—Process of coating sheet metal. Edwin Norton, Maywood, Ill.

**488,528**.—Concentrator. William P. Ogden, Denver, Col.

*(Issued December 27, 1882.)*

**488,534**.—Explosive. John F. Alexander, Washington, D. C.

A powder composed of "naphthaline, or suitable solid hydrocarbon, and sulphur, a potassium salt or salts, picrate of ammonium, and sulphate of ammonium in variable proportions."

**488,580**.—Apparatus for making alumina. Henry W. Shepard, Camden, N. J.

**488,583**.—Apparatus for separating solid matter from liquids. Gustave Sobotka, New York, and William Ahrens, Long Island City, N. Y.

**488,611**.—Thermostatic indicator and adjuster. Emil C. C. Krogh, Monmouth, Ill.

**488,621**.—Filter. Simeon L. West, Washington, D. C.

**488,622**.—Brick machine. Bruce C. White, Chicago, Ill.

**488,628**.—Method or process of treating sludge. Hans A. Frasch, Cleveland, Ohio.

**488,645**.—Push bottom and thermostat. Edward L. Ashley and Wallace H. Camp, Waterbury, Conn.

**488,646**.—Injector burner. Amos L. Avery, Bradford, Pa.

**488,660**.—Oil burner. William F. Otis, Norwalk, Ohio.

**488,661**.—Melting furnace. William Rebmann, Chicago, Ill.

**488,664**.—Condensing apparatus. Matthias J. Reuber and Edwin G. Stone, Pittsburg, and Peter Fuchs, Lower St. Clair, Pa.

**488,672**.—Centrifugal liquid separator. Jesse E. Folk, Brooklyn, N. Y.

**488,673**.—Water purifier. Madden J. Hewlett and De John C. Cecil, Paducah, Ky.

**488,682**.—Artificial stone. Anton Sladoslawck, Chicago, Ill.

**488,683**.—Producing enameled iron ware. Carl A. W. Vollrath, Sheboygan, Wis.

A process for "producing speckled enameled iron ware, which consists in mixing two enamels having different fusibility and ground to different degrees of coarseness, applying them to the article, drying and fusing."

488,702.—Apparatus for washing sodium bicarbonate. Karl J. Sundstrom, Brooklyn, N. Y.

488,708.—Electrolytic apparatus. •Thomas Craney, Bay City, Mich.

488,709.—Water heater. John Dawson, Huddersfield, England.

488,726.—Secondary battery. Nicholas Waldimiroff, St. Petersburg, Russia.

488,766.—Alembic. Victor J. Kuiss, Paris, France.

488,767.—Destructive distillation of mineral oils. John Laing, Edinburgh, Scotland.

488,770.—Grain drier. William McKee, Chicago, Ill.

488,796.—Process of utilizing tin scrap. Harold B. Nye, Cleveland, Ohio.

The tin scraps are melted "into an alloy with pig or other iron, and removing the tin and other metals and impurities alloyed with the iron by oxidation by forcing blasts of air under pressure into intimate contact with all parts of the molten alloy."

488,798.—Air cooling and purifying apparatus. George E. Proctor, Washington, D. C.

488,801.—Coffee substitute and method of preparing same. Heinrich Trillich, Munich, Germany.

The process consists in "soaking malt, then roasting the same, then spraying the same; the result is a liquor containing the aromatic essence of coffee and sugar: the further heating the same until the shell or husk of the malt becomes covered with a saccharine coating, and finally, covering the grains with a film of fat and rapidly cooling the same." Hence, grains of malt impregnated with the aromatic essences of coffee to the exclusion of caffeine.

488,813.—Feed water purifier. William B. Hosford, Mishawaka, Ind.

488,824.—Generator. William B. Macdonald, Allegheny, Pa.

488,859.—Apparatus for filling and stopping bottles. Dennis Wickham, Ware, England.

488,867.—Crushing roll. Daniel Brennan, Jr., Bayonne, N. J.

488,881.—Carbureter. William Falley and James Falley, Lafayette, Ind.

488,883.—Brick cutting machine. Charles T. Fitch and Andrew, Schautz, Perth Amboy, N. J.

488,898.—Process of testing materials containing metals. Robert F. Neuninger, Newark, N. J.

488,953.—Incubator. Henry M. Scheer, Quincy, Del.

488,956.—Apparatus for separating solid matter from liquids. Gustave Sobotka, New York, and William Ahrens, Long Island City, N. Y.

**488,967.**—Process of and apparatus for vulcanizing wood. Samuel E. Haskin, Aroca, N. Y.

Heated compressed air is circulated through the vulcanizing chamber and then, without interrupting the circulation or relaxing the pressure, successive volumes of cold air are introduced into the circulating system until the wood is cooled down below the boiling point of its liquid or liquifiable constituents.

J. F. G.



**EXCHANGES RECEIVED BY THE AMERICAN CHEMICAL SOCIETY.**

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*(To be found in the Library.)*

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**UNITED STATES. American Chemical Journal.**

**American Druggist.**

**American Gas Light Journal.**

**American Journal of Pharmacy.**

**American Manufacturer and Iron World.**

**American Naturalist.**

**Annals of the New York Academy of Sciences.**

**Anthony's Photographic Bulletin.**

**Bulletin of the American Museum of Natural History.**

**Bulletin of the Connecticut Agricultural Experiment Station.**

**Bulletin of the Massachusetts State Agricultural Experiment Station.**

**Circulars of Information, Bureau of Education, Washington, D. C.**

**Deutsch-Amerikanische Apotheker-Zeitung.**

**Druggists' Circular.**

**Engineering and Mining Journal.**

**Engineering Magazine.**

**Ephemeris (Sqibb).**

**Journal of Analytical and Applied Chemistry.**

**Journal of the Franklin Institute.**

**Journal of the United States Artillery.**

**Manufacturer and Builder.**

**Manufacturers' Review and Industrial Record.**

**Medico-Legal Journal.**

**New Idea.**

**New York Medical Journal.**

**Oil, Paint and Drug Reporter.**

**Pharmaceutical Record.**

**Popular Science Monthly.**

**Proceedings of the Academy of Natural [Sciences, Philadelphia.**

**Proceedings of the American Academy of Arts and Sciences, Boston.**

- UNITED STATES.** Proceedings of the American Philosophical Society, Philadelphia.  
 Reports of the Geological Survey of Pennsylvania.  
 Reports of the Storrs School Agricultural Experiment Station.  
 Report of the Bureau of Statistics of Imports, Exports, Immigration and Navigation.  
 School of Mines Quarterly.  
 Scientific American.  
 Technology Quarterly.  
 Textile Colorist.  
 Transactions of the American Institute of Electrical Engineers.  
 Transactions of the American Institute of Mining Engineers.  
 Transactions of the New York Academy of Sciences.
- CANADA.** Journal and Proceedings of the Hamilton Association.  
 Proceedings of the Canadian Institute.  
 Reports of the Geological Survey of Canada.
- CHILI.** Verhandlungen des deutsch-wissenschaftlichen Vereins zu Santiago.
- MEXICO.** Boletin del Ministerio de Fomento.  
 Boletin Mensual.  
 Informes y Documentos Relativos á Comercio, etc.  
 Memorias y Revista de la Sociedad Científica.
- HOLLAND.** Revue Internationale des Falsifications.
- ITALY.** Gazzetta Chimica Italiana.
- GREAT BRITAIN.** Analyst.  
 Chemical News.  
 Engineering.  
 Industries.  
 Invention.  
 Iron.  
 Journal of the Chemical Society.  
 Journal of the Society of Arts.  
 Journal of the Society of Chemical Industry.  
 Oil and Colorman's Journal.  
 Pharmaceutical Journal and Transactions.  
 Sugar Cane.  
 Transactions of the Laboratory Club.  
 Transactions of the Institute of Brewing.
- FRANCE.** Annales des Mines.  
 Bulletin de la Société Chimique de Paris.  
 Bulletin de la Société Industrielle de Rouen.  
 Moniteur de la Teinture.  
 Moniteur Scientifique de Quesneville.  
 Repertoire de Pharmacie.

487,261.—Ore concentrating machine. Andrew Frazer, San Francisco Cal.

487,285.—Electrical heater. Willis Mitchell, Malden, Mass.

487,286.—Glass tank furnace. William F. Modes, Streator, Ill.

487,300.—Steam generator. Wright D. Smith, Detroit, Mich.

487,310.—Method of heating by metal bath. Frederick L. White, Milwaukee, Wis.

487,316.—Centrifugal butter extractor. Gustav M. Andersson, Newark, N. J.

487,317.—Means for superheating steam. Alexander Beatobuloff, Bielaia Turkov, Russia.

487,323.—Apparatus for separating molasses from sugar. Emmett A. Ellis, Sartartia, Tex.

487,324.—Galvanic battery. James L. Gethino, Boston, Mass.

487,338.—Method of mixing alloys. William R. Thomas, Catasauqua, Pa.

487,339.—Ice shaving machine. George B. Webb, Kinston, N. C.

487,342.—Process of carbonating fermented beverages. Jacob F. Wittermann, Yonkers, N. Y.

487,349.—Machine for plucking hairs from skins. Frank J. Murphy, Danbury, Conn.

487,370.—Ice cream freezer. Henry Mayers, San Francisco, Cal.

487,384.—Automatic faucet. Aaron A. Belleau, Brooklyn, N. Y.

487,390.—Ozone tube. Oscar Frohlist, Berlin, Germany.

487,405.—Beer cooler. John F. Duffy, Brooklyn, N. Y.

487,421.—Oil filter. Oscar Lindberg, Helsinborg, Sweden.

487,425.—Method of preparing glass metal. Roger S. Pease, Rose, Minn.

487,426.—Apparatus for moulding glass metal, etc. Roger S. Pease, Rose, Minn.

487,431.—Bakers' oven. George R. Skillmann, Baltimore, Md.

487,439.—Process of manufacturing sugar. Edward C. Bartheleny, New Orleans, La.

487,444.—Process of smelting ores containing zinc. Henry A. Hunicke, St. Louis, Mo.

487,467.—Filtering system. Robert Beyrle, Los Angeles, Cal.

487,478.—Mercurial air pump. Gustav A. Frei, Springfield, Mass.

487,507.—Apparatus for mixing flour or other materials. John D. Bangert, Baltimore, Md.

487,511.—Ore rake. John C. Blau, Wilmington, Del.

487,519.—Thermostat. Franklin O. Elliott, Catawaba, N. C.

487,521.—Automatic damper for furnaces, etc. David W. Glendenning, Denver, Col.

487,523.—Ore concentrator. Alfred Gonzalez, San Francisco, Cal.

**487,531.**—Barrel filler. Karl Kiefer, Cincinnati, Ohio.

**487,542.**—Device for operating ore concentrators and allied machines. Charles E. Seymour, Lake Geneva, Wis.

**487,549.**—Feed water heater. William J. Austin, Fond du Lac, Wis.

**487,579.**—Process of treating gold and silver ores. George W. McGee, Chicago, Ill.

The crushed ore is submerged in a solution of caustic soda or potash, after which salts of oxalic acid are added and the liquid evaporated.

**487,588.**—Disinfecting apparatus. Emil Taussig and Salomon Taussig, New York, N. Y.

**487,605.**—Combined furnace for treating and reducing ores and for refining the resulting metals. Antoine Chabaud, L. Leopold Van Heers and Louis A. Allard, St. Louis, Mo.

**487,606.**—Coating surfaces with plastic material. Melvin B. Church, Grand Rapids, Mich.

**487,607.**—Method of arc and incandescent metal heating. Charles L. Coffin, Detroit, Mich.

**487,614.**—Filter. Warren R. Evans, Portland, Me.

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"A liquid composition for tempering metals, consisting of twenty grains of potassium bromide to one gallon of crude lubricating oil and double the quantity of soft water."

**488,470.**—Process of reducing franklinite ores. George G. Corners, Salisbury, Pa.

Process of "treating ores containing franklinite, willemite and zincite, which consists in treating the franklinite to render it magnetic, separating it by magnets from the willemite and zincite, reducing the willemite and zincite to spelter by a Belgian or other suitable furnace, treating the franklinite in the Wetherill or other suitable furnace for the manufacture of oxide of zinc and smelting the residuum from the franklinite for spiegeleisen."

**488,471**.—Process of treating franklinite and willemite. George G. Corners, Salisbury, Pa.

Similar to the above.

**488,479**.—Anti-fouling paint. Anson L. Munson, East Oakland, Cal.

An anti-fouling paint containing a pigment, mercurous chloride, and a vehicle consisting of coal tar, chloride of zinc and oil of turpentine.

**488,517**.—Apparatus for moulding pulp. Stanley L. Chapman, Evanston, Ill.

**488,519**.—Self purifying superheating steam generator. Benjamin F. Field, Chicago, Ill.

**488,524**.—Feed water heater and purifier. James MacDonald, Los Angeles, Cal.

**488,527**.—Process of coating sheet metal. Edwin Norton, Maywood, Ill.

**488,528**.—Concentrator. William P. Ogden, Denver, Col.

*(Issued December 27, 1882.)*

**488,534**.—Explosive. John F. Alexander, Washington, D. C.

A powder composed of "naphthaline, or suitable solid hydrocarbon, and sulphur, a potassium salt or salts, picrate of ammonium, and sulphate of ammonium in variable proportions."

**488,580**.—Apparatus for making alumina. Henry W. Shepard, Camden, N. J.

**488,583**.—Apparatus for separating solid matter from liquids. Gustave Sobotka, New York, and William Ahrens, Long Island City, N. Y.

**488,611**.—Thermostatic indicator and adjuster. Emil C. C. Krogh, Monmouth, Ill.

**488,621**.—Filter. Simeon L. West, Washington, D. C.

**488,622**.—Brick machine. Bruce C. White, Chicago, Ill.

**488,628**.—Method or process of treating sludge. Hans A. Frasch, Cleveland, Ohio.

**488,645**.—Push bottom and thermostat. Edward L. Ashley and Wallace H. Camp, Waterbury, Conn.

**488,646**.—Injector burner. Amos L. Avery, Bradford, Pa.

**488,660**.—Oil burner. William F. Otis, Norwalk, Ohio.

**488,661**.—Melting furnace. William Rebmann, Chicago, Ill.

**488,664**.—Condensing apparatus. Matthias J. Reuber and Edwin G. Stone, Pittsburg, and Peter Fuchs, Lower St. Clair, Pa.

**488,672**.—Centrifugal liquid separator. Jesse E. Folk, Brooklyn, N. Y.

**488,673**.—Water purifier. Madden J. Hewlett and De John C. Cecil, Paducah, Ky.

**488,682**.—Artificial stone. Anton Sladoslawck, Chicago, Ill.

**488,683**.—Producing enameled iron ware. Carl A. W. Vollrath, Sheboygan, Wis.



A process for "producing speckled enameled iron ware, which consists in mixing two enamels having different fusibility and ground to different degrees of coarseness, applying them to the article, drying and fusing."

488,702.—Apparatus for washing sodium bicarbonate. Karl J. Sundstrom, Brooklyn, N. Y.

488,708.—Electrolytic apparatus. Thomas Craney, Bay City, Mich.

488,709.—Water heater. John Dawson, Huddersfield, England.

488,726.—Secondary battery. Nicholas Waldimiroff, St. Petersburg, Russia.

488,766.—Alembic. Victor J. Kuiss, Paris, France.

488,767.—Destructive distillation of mineral oils. John Laing, Edinburgh, Scotland.

488,770.—Grain drier. William McKee, Chicago, Ill.

488,796.—Process of utilizing tin scrap. Harold B. Nye, Cleveland, Ohio.

The tin scraps are melted "into an alloy with pig or other iron, and removing the tin and other metals and impurities alloyed with the iron by oxidation by forcing blasts of air under pressure into intimate contact with all parts of the molten alloy."

488,798.—Air cooling and purifying apparatus. George E. Proctor, Washington, D. C.

488,801.—Coffee substitute and method of preparing same. Heinrich Trillich, Munich, Germany.

The process consists in "soaking malt, then roasting the same, then spraying the same; the result is a liquor containing the aromatic essence of coffee and sugar: the further heating the same until the shell or husk of the malt becomes covered with a saccharine coating, and finally, covering the grains with a film of fat and rapidly cooling the same." Hence, grains of malt impregnated with the aromatic essences of coffee to the exclusion of caffeine.

488,813.—Feed water purifier. William B. Hosford, Mishawaka, Ind.

488,824.—Generator. William B. Macdonald, Allegheny, Pa.

488,859.—Apparatus for filling and stopping bottles. Dennis Wickham, Ware, England.

488,867.—Crushing roll. Daniel Brennan, Jr., Bayonne, N. J.

488,881.—Carbureter. William Falley and James Falley, Lafayette, Ind.

488,883.—Brick cutting machine. Charles T. Fitch and Andrew, Schautz, Perth Amboy, N. J.

488,898.—Process of testing materials containing metals. Robert F. Neuninger, Newark, N. J.

488,953.—Incubator. Henry M. Scheer, Quincy, Del.

488,956.—Apparatus for separating solid matter from liquids. Gustave Sobotka, New York, and William Ahrens, Long Island City, N. Y.

**488,967.**—Process of and apparatus for vulcanizing wood. Samuel E. Haskin, Aroca, N. Y.

Heated compressed air is circulated through the vulcanizing chamber and then, without interrupting the circulation or relaxing the pressure, successive volumes of cold air are introduced into the circulating system until the wood is cooled down below the boiling point of its liquid or liquifiable constituents.

J. F. G.

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- GERMANY.** Archiv der Pharmacie.  
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Jahresbericht der Chemischen Technologie [Wagner], for 1891.  
Sitzungsberichte der K.B. Akademie der Wissenschaften zu München.
- PERU.** Boletin de Minas.
- AUSTRIA.** Allgemeine Oesterreichische Chemiker und Techniker Zeitung.  
Chemisch Technischer Central Anzeiger.  
Drogisten Zeitung.  
Jahrbuch de K. K. Geologischen Reichsanstalt.  
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- RUSSIA.** Bulletin de l'Academie Imperiale des Sciences de St. Petersburg.  
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Chemical Bulletins of the U. S. Agricultural Department.  
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